A Textbook of General Psychology

Walter F. Daves

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To Susan, Phillip, Carole, and Maryann

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Preface

To tell what psychology is about, and to tell it in such a way that students in an introductory course can be led, or lead themselves, from what they already know to a reasonable understanding of the major concepts and developments in the field—these are the aims of this textbook. George Miller, a former president of the American Psychological Association, once made the statement that the main ideas of psychology can be understood by the average sixth grader and that psychologists should be ready to communicate their knowledge to such an audience. Whether or not you believe this to be true, either before or after you read this book, the writer of an introductory textbook is challenged to present his material in a manner that can be easily understood by students with a wide range of backgrounds. For this reason, every attempt has been made to minimize psychological jargon, and, where specialized terms must be used, to define them as clearly as possible.

Psychology, like other fields of study, has burgeoned in the last 40 or so years. More and more people are doing more and more research, and publishing more and more papers, books, and journal articles. It is becoming increasingly difficult for one person to keep up with what is going on in any one area, let alone master the whole. The problem is particularly acute in the introductory course. It has even been suggested that introductory psychology cannot be taught—period; and in some universities the course has been eliminated from the curriculum. Other institutions have taken a circumscribed approach, offering a course with a limited subject matter and objectives, and making no attempt to cover all of the major areas within psychology. While such a solution to the problem of proliferation has some merit, it appears to this writer that there is also merit in the idea that a course in psychology *can* be a significant contribution to a liberal arts education and at the same time provide a prospective major in psychology with enough information to decide whether or not to pursue the field further.

A textbook for such a course should meet certain requirements. First of all, it ought to be short enough that the instructor will not have to eliminate major portions and thereby lose whatever continuity is present. However, it should also be reasonably complete, elaborating the major concepts that have developed in the various fields of psychology. The level of elaboration should be responsive to the question: "If this were the only course in psychology that students would take, what should they know in order to have a reasonable appreciation for the field and to know where to go if they want to

find out more?" Thus, there should not be too much detail in any one area, but there should be enough by way of basic concepts that the student will have an indication of what to expect in more advanced courses.

The textbook in such a course should also be integrative. In spite of the proliferation within the subfields of psychology and the resulting tendency for conceptual separations between areas, there are still some commonalities which tie groups of areas together. Wherever possible, an introductory textbook should make note of these commonalities and show how different areas are related to one another. Such integration can and should be done, but without forcing issues. For example, there are several different approaches to the study of personality. While they are clearly different from each other, each approach has its counterpart in other problem areas, for example, in the case of personality, perception, learning, and thinking. This kind of conceptual commonality should be noted wherever possible. While this book is not organized around common themes, the attempt has been made to deal with them where they are apparent.

Finally, even in a changing world in which psychology and psychological concepts are subject to almost continuous revision, there appears to be merit in maintaining something in the way of traditional modes of organization of the subject matter, if for no other reason than to provide some continuity with the past. Therefore, this textbook is traditional in its organization, while attempting to include the best of current thinking and research. Old findings and ideas, however, are not excluded simply because they are old; many must be included because nothing new and of equal conceptual importance has proven fully satisfactory.

I wish to note that many people have provided me with the counsel, criticism, encouragement, and manual assistance that was necessary for the completion of this book. My editors at Crowell were quite helpful and patient in guiding me through the maze out of which the book eventually emerged. Harold Vetter, Nowell Jones, James Dabbs, and Duane Rumbaugh critically read various portions of the manuscript. Catherine Smith, Diana Dupont, Micah Nichols, Jean Britt, Elaine Wood, and Judy Adelman assisted in the preparation of parts of this book and the instructor's manual. Joyce Thompkins, Patricia Ward, and Mayvin Sinclair typed portions of the manuscript. To all of these people I am deeply appreciative.

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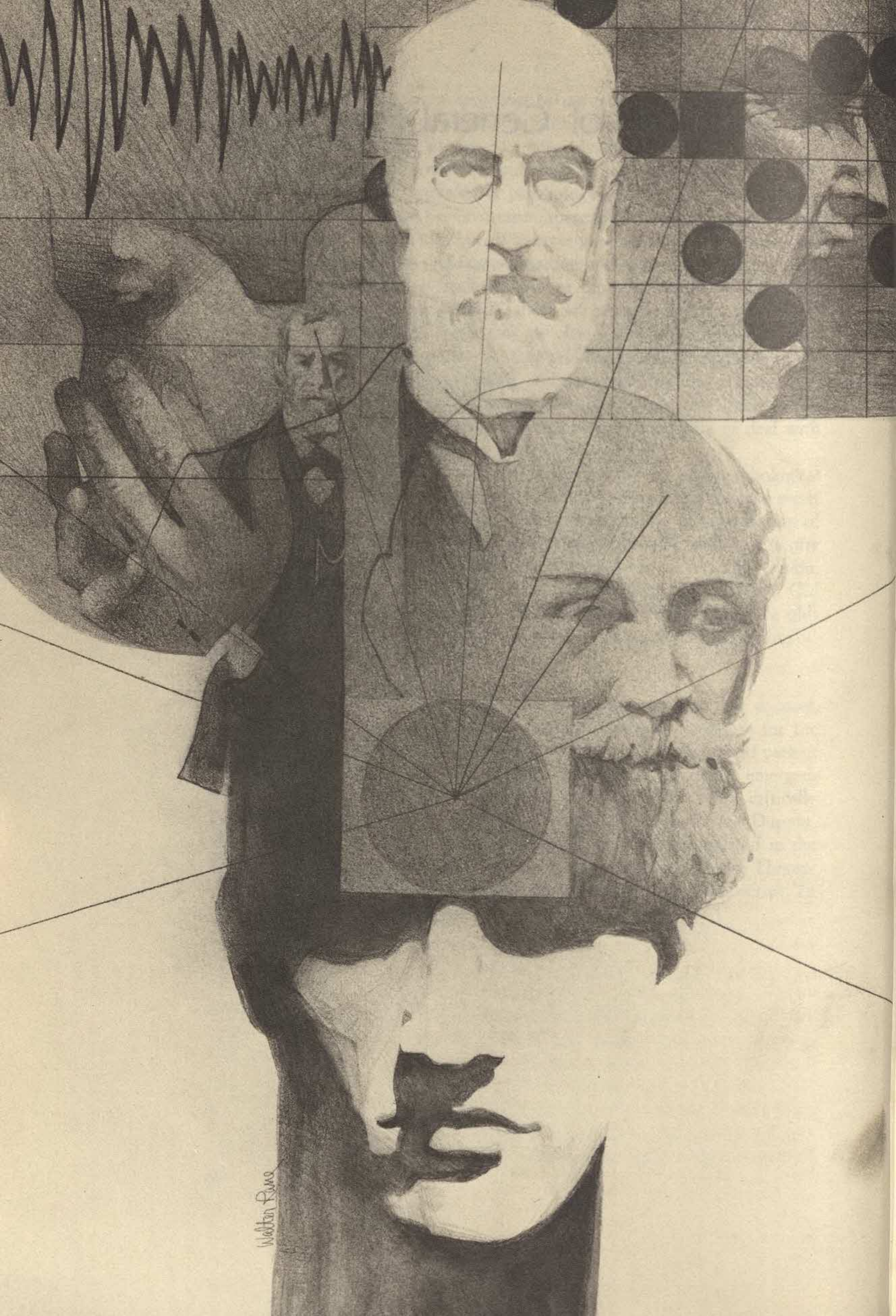

Walter Rane

Psychology: A Perspective

1

This book is about psychology and psychologists—what psychology is and what psychologists do. It is also about behavior and experience, because that is what psychologists study. It is about heredity and about the brain. It is also about how the brain is used: perceiving, learning, remembering and forgetting, performing skilled actions, thinking, using language, being motivated, having and communicating emotional experience, being bright and dull, developing and expressing a personality, being normal or deviant, trying to correct deviant behavior, and living one's life in relation to others. It is about people as well as lower animals, because understanding one species often requires an equivalent understanding of other groups as well. It is about all of these subjects, each of which could make up a whole college course or a lifetime of study, because they all are important aspects of behaving and experiencing. Your encounter with these topics will be quite limited relative to what could be done if each were covered exhaustively, but you may expect to learn where to look if you wish to know more about any particular topic. In any event, you should be able to learn enough about each area so that you will have a pretty good idea of what it is about and understand how it fits into the overall scheme of psychology's program for dealing with behavior and experience.

From its rather simple beginning as an outgrowth of philosophy, physiology, and biology, psychology has developed into a collection of subfields, each of which focuses in some way upon behavior and/or experience. Some psychologists aim to increase our understanding of behavior and experience, and for them *psychology is primarily a science.* Other psychologists, confronted with various human problems upon which psychological knowledge bears, spend a good bit of their time attempting to solve such problems. For

them *psychology is primarily a profession*. Many psychologists do both—some of their time is spent in research aimed at understanding and explanation, and at other times they are engaged in the practice of psychology. While psychologists may differ among themselves as to which of the two activities is more important, most realize that the two can contribute in essential ways to one another. For example, the knowledge gained through research has in many instances contributed greatly to the solution of human problems. Similarly, in attempting to deal directly with "real-world" problems one can learn a great deal about aspects of behavior and experience that would not necessarily be spontaneously encountered in the research laboratory. One can also develop an appreciation for the limitations of current knowledge; perhaps this appreciation will lead one to develop laboratory studies to fill the gaps. Thus the two aspects of psychology complement each other.

In the remainder of this chapter the idea of psychology as a science and a profession will be developed. The various fields of psychology as we know them today will be described briefly, and you will see how psychology got to be the way it is today from its early beginnings.

Psychology as a Science

Psychology is often said to be the science of behavior and experience. You may also have heard that psychology is the study of the mind. The second definition was more popular 100 years ago than it is today, primarily because the concept of mind is extremely difficult to come to grips with. Behavior would appear easier to comprehend since much of it can be observed. Experience (in the sense of your or my experience of the color red, or of anger when treated unfairly, or of appreciation for a symphony) is harder to deal with than behavior, since, although you can observe my behavior directly, you can only know about another person's experience indirectly—by observing his report of his experience. For this reason some psychologists, called behaviorists, would focus upon behavior to the exclusion of experience. Others feel that experience is too important to ignore, regardless of the difficulties in studying it. The same argument could be made about mind, that it is too important to ignore, and some psychologists are beginning to reintroduce the concept of mind into psychology. Thus, in recent years, an approach known as *cognitive psychology* has developed, in which the study of mental processes plays an important role. You will see more of this topic presently.

The Study of Behavior

Behavior is itself a very broad concept, and the term is used in various ways by various people. A physicist might, for example, talk about the behavior of an electron, or a teacher about the poor behavior of a student. In psychology, behavior usually refers to a more limited set of phenomena. First of

all, psychologists usually limit themselves to the study of the behavior of animals, including human beings. (Although the word "organism" is used quite often in talking about creatures that behave, it is safe to say that, for the most part, plant organisms are not studied in psychology.) Second, behavior is considered as an activity of the creature, rather than something that just happens to him. Falling into an open manhole, for example, is not necessarily behavior in this sense, in that it could be something that "just happens" to a person. On the other hand, if it could be shown that a given person not only falls into open manholes, but also has a lot of automobile accidents, bumps into other people a lot, always cuts himself when he shaves, and has a tendency to swim out too far in the ocean, then one might consider that falling into open manholes *is* behavior, since it seems to fit into an overall picture which, for that person, involves a number of potentially destructive things "happening" to him. In other words, he might be said to be "accident-prone," which is important psychologically. Other examples of behavior that could obviously be included in the definition are snoring, taking a test in psychology, going to the cafeteria, memorizing a list of words, betting on the horses, and blinking the eyelid when a puff of air is directed to the eye. A cat's clawing of the furniture, a rat's becoming "bait-shy," and a flatworm's learning to writhe in response to a light after the light has been followed by electric shock on previous occasions are other examples. Behavior may be voluntary or involuntary, as the list suggests, but in each case it is considered as an activity.

The list above illustrates in a rough way the range of behavior studied by psychologists. Some behaviors, such as a person's blinking the eyelid and a flatworm's learning to writhe in response to light, are rather specific and are selected for particular reasons, such as the ease of study in a controlled laboratory situation or because the particular behavior or animal has properties that are of theoretical interest. Other behaviors such as going to the cafeteria are less specific and minute, and frequently less amenable to study in a controlled laboratory situation.

Which of the wide range of behaviors one is going to study depends upon a number of considerations. Quite often, psychologists deal with rather large units of behavior, such as having accidents, for practical reasons. A particular person may come to him with that problem, or perhaps the psychologist has a theory of accident-proneness which he would like to test by determining the number of times that particular individuals have accidents. Another psychologist might spend many hours dealing with the eye-blink reflex because this reflex provides a convenient way in which to study certain aspects of the conditioning process. (Conditioning is a form of learning and, as you will see later, may be important in the acquisition of emotional responses.)

A third psychologist might devote himself to the study of students' behavior in memorizing long lists of unrelated words because this task best enables him to get at some aspect of the way human memory works. There are usually good reasons for selecting a particular level of behavior for study, and you will find your understanding of psychology to increase considerably

if you will ask yourself the following question when you read about particular kinds of behavior, "Why is this behavior studied at this level and not at a more minute (or more gross) level?"

Psychologists frequently use the term *molar* to refer to the grosser behavioral units, and *molecular* to refer to the more minute units. Having accidents and going to the cafeteria are examples of relatively molar behavior, while blinking the eyelid is relatively molecular. That these terms express the *relative* minuteness or grossness of analysis should be clear. The eye-blink reflex is quite molar relative to the study of the neural and muscular events underlying the reflex.

The Study of Experience

Most people consider subjective, or private experience, to be a very significant part of their everyday lives. The music lover, for example, listens to music for the *experience* it gives him. It may bring out emotional feelings that other events leave hidden, or it may stimulate his imagination to the extent of producing vivid visual images, or he may appreciate intellectually the way in which a melody is woven into the larger context of a symphony. To put it differently, the music is significant to him in a way that is unique to his own make-up. Its significance is very real to him, but it may be extremely difficult to communicate to another person. Similarly, the experience evoked in a spectator at a close football game may be quite significant to him (certainly significant enough to make athletics a very big business), and perhaps quite different from the experience evoked in his neighbor, although both may be ardent football fans.

The study of experience has come into prominence in recent years along with interest in "altered states of consciousness" produced by drugs such as LSD and marijuana, and meditational and other religious practices that apparently alter the way one experiences the world. While knowledge about the effects of such things on experience is indeed very old, it is only in recent years that more than a few psychologists have become interested in the phenomena.

Many experiences that people have, especially those of an emotional nature, may manifest themselves in behavior that can be observed by another person. For example, the football fan may behave in such a way (shouting, waving his hands, swearing at the referee, etc.) that even an unskilled observer might be able to figure out some aspects of his private experience. At a more molecular level, certain broad aspects of emotional experience, such as fear and excitement, are reflected in the behavior of the autonomic nervous system (Chapter 4). The pupils of the eye, for example, often dilate (become larger) when one experiences pleasure, and chemical changes occur in the skin which can be measured with special equipment when one experiences fear. Other experiences may not be communicated except through verbal description, such as "I feel like I'm about to jump out of my skin," or "Those clouds look like pink cotton candy."

In all of the above examples, the person's experience is made more or less public by means of some kind of behavior. Except by means of recording

Psychology and Human Welfare

Scientific psychology, like other areas within science, has often been accused of lacking relevance for human concerns. Indeed, one of the hallmarks of the academic revolution occurring during the 1970s is the drive toward relevance: Make the academic experience relevant to the problems that a student will encounter in "real life." When this demand is applied to psychology, it is often read as a call for an improved technology of behavior—the development of techniques for curing mental illness, or teaching retarded children how to read, or for making workers willing to work harder for less pay. In a word, the move is for the development of improved means for controlling behavior.

This focus on behavior control leaves a bad taste in the mouths of many people, for there is the implication of loss of freedom at the hands of a bureaucratic elite who will have the power to exercise the control.

George A. Miller, a former president of the American Psychological Association, has made some rather thought-provoking comments on this problem (1969). In the first place, he suggests that the real impact that scientific psychology will have on human life is not so much technological as it is conceptual. Scientific psychology has, he argues, the potential for altering man's conception of himself, *and the implications of this fact are quite far-reaching. Just consider the impact that Sigmund Freud's work has had on our present conception of human nature. As a cure for mental illness, psychoanalysis may perhaps be considered a gigantic flop. However, the idea that behavior is determined by unconscious processes, particularly those concerning sexual motivation, has had far-reaching consequences.*

Miller argues that in order for the impact of scientific psychology to be felt, however, it must be given away to the public at large. The man in the street must be taught to be a psychologist. He suggests that if the basic ideas of psychology are appropriately presented, they can be grasped by a sixth-grade child. This means teaching people to apply psychological principles to problems of relevance to themselves. If such is indeed possible, the technological advances that might accrue as a result of scientific psychology would be available to everyone, not just to a handful of PhD's who guard with jealousy their professional secrets.

Giving psychology away, however, requires that the recipient, the public, be desirous of receiving it, and, unfortunately, much of present-day scientific psychology is regarded as somewhat of a Trojan Horse. Miller attributes this reluctance to welcome us with open arms to our focus on the control of behavior, with all of the consequences mentioned above. Perhaps, he suggests, it would be better to deemphasize the matter of control of behavior as a means for solving social problems. Psychologists could just as well point out that psychological knowledge can free man to achieve his goals more

effectively, to become more competent at doing whatever he will, and to become happier for it. Thus,

> *If a supervisor is having trouble with his men, perhaps we should teach him how to write a job description and how to evaluate the abilities and personalities of those who fill the job; perhaps we should teach him the art of persuasion, or the time and place for positive reinforcement. If a ghetto mother is not giving her children sufficient intellectual challenge, perhaps we should teach her how to encourage their motor, perceptual, and linguistic skills (p. 1073).*

behavior, psychologists have thus far found no way to make one person's experience known to another. And yet one is never quite sure about the precise relationship between the behavior and the experience. That is why the study of experience is always more difficult than the study of behavior alone. Experience is always inferred from behavior, and the more indirect the relation between the behavioral index and the experience, the less certain one is about the experience. In spite of the difficulties, however, many psychologists feel that in view of the importance of experience to everyday life, it is necessary to proceed to study it with whatever techniques are available. Some progress is being made, fortunately, and there has been a good bit of research in recent years on topics such as the communication of emotional states (see Chapter 14); electrical brain activity associated with imagery and dreaming; and different experiences produced by various procedures, such as the administration of hallucinogenic drugs (e.g., LSD).

You need to be aware that some psychologists assert that, because it is "private," one can never study experience scientifically, since science is thought to depend for its knowledge upon *direct* observation (see Chapter 2). The founder of behaviorism, John B. Watson, for example, doubted that consciousness was useful as a scientific concept. Many psychologists, called behaviorists, have followed in Watson's footsteps and consider experience to be outside the scope of psychology. Today Watson's influence seems to be waning, and experiential studies are on the increase. Perhaps in another generation we shall be able to talk in a much more systematic way about experience.

The Study of the Mind

Over 100 years ago, before psychology became an independent discipline, the term "psychology" was often used to refer to the study of the mind. As such, it was largely within the province of philosophy and certain branches of medicine concerned with the treatment of mental disturbances. Discussions as to the nature of the mind, the relation between the mind and the body, whether animals had minds, etc., were endless, and, to many of those impatient to develop psychology as an independent, productive disci-

pline, fruitless as well. Consequently, references to the mind began to decrease in number, and references to behavior, about which theoretically there should be agreement among observers, began to increase. Finally, John B. Watson, in formulating his edict concerning psychology as the study of behavior (1913) sounded the death knell for mentalistic notions in psychology for a long time. Because he was so influential, and because behaviorism *did* work—i.e., psychologists were able to agree for the most part about their observations of behavior, and to develop some theories about behavior—most psychologists concentrated on behavior. At that time only the bravest psychologist would even dare to mention the word "mind" in a serious publication. Now, since self-conscious behaviorism is coming to be less and less in style, one finds more and more references to the mind, or to mental events, in the writings of psychologists.

The rise in prominence of "cognitive psychology" is a case in point. The term cognitive is derived from a Latin word meaning "to know," and, in the broadest sense, cognitive psychology is concerned with those processes whereby we come to know and to utilize that knowledge. Such processes include perception, imagery, memory, and thinking. Many of the recent concepts developed in these areas sound very mentalistic, i.e., it sounds as though psychologists are talking about operations that the mind performs in order to deal with knowledge. Developments in this field have made it quite clear that, in contrast with Watson's dictum, such mental operations *can* be studied systematically, in such a way that different investigators have a reasonable chance of agreeing with each other without degenerating into useless debates. The reason is that modern cognitive psychology, although focusing upon mental operations, does so by studying behavior. In other words, the mind is studied indirectly through behavior.

Psychology as a Profession

As a profession psychology includes numbers of highly trained individuals. Most professional psychologists have had approximately 4 years of graduate training in addition to 4 years of college work. The usual academic degree for a professional psychologist is the PhD, although some psychologists stop with the MA or MS degree. In this respect psychology is unlike some professions, such as engineering, which usually require only a bachelor's degree. It is more like law or medicine, both of which require a considerable amount of work past the baccalaureate. Many states have laws providing for the licensing of psychologists as professionals, and at the national level the American Board of Examiners in Professional Psychology examines psychologists in the fields of clinical, counseling, and industrial psychology. Those who pass are awarded a diploma in their field.

Psychologists in all of the subareas of psychology find the opportunity to practice their discipline in the solution of problems. These areas will be discussed at greater length later in this chapter. It is sufficient to mention here that clinical psychologists, counseling psychologists, experimental psy-

chologists, developmental psychologists, social psychologists, and even comparative (animal behavior) psychologists sometimes find their talents to be in demand in the marketplace. The work they do includes such different tasks as training animals for advertising displays, helping in the design of aircraft work stations, treating patients with personality disturbances, and teaching people how to function more effectively in groups.

Just as progress in the practice of medicine depends in large measure upon the development of knowledge in the basic health sciences (physiology, anatomy, biochemistry, pharmacology), progress in the practice of psychology depends upon the development of knowledge about psychological processes such as learning, perception, thinking, motivation, and the emotions. One is frequently a better practitioner if he understands what is going on than if he simply applies "rules of thumb" to problems. The converse is also the case: The health sciences have been aided in their development by taking cognizance of disease processes discovered in the practice of medicine, since disease processes frequently reflect the abnormal functioning of parts of an otherwise normal body. Thus an understanding of how the body metabolizes the sugar glucose was prodded by the fact that some people suffer from diabetes, a disease that involves a deficiency in sugar metabolism. In psychology, our understanding of, for example, thought processes may be partly aided by studies of schizophrenia, one symptom of which is disordered thinking. Unfortunately, many psychological processes are not as easy to study as glucose metabolism, so the contribution of abnormal psychology to an understanding of normal processes is not as straightforward as its analog in medicine. However, the essence of the reciprocal relationship between professional, or applied, and scientific psychology is there to be exploited by creative psychologists.

The Fields of Psychology

In keeping with the distinction made earlier between the scientific and the professional aspects of psychology, we shall consider separately those fields of psychology which are primarily concerned with increasing understanding of behavior and experience, and those which are mainly oriented toward the solution of practical problems. We shall call these the "basic science fields" and the "applied fields," respectively. After these fields are described, you will see how the two approaches complement one another in respect to several selected problem areas.

Basic Science Fields

EXPERIMENTAL PSYCHOLOGY

Experimentation is characteristic of all areas of psychology, and perhaps for this reason the term is becoming inappropriate as a label for an area of psychology. However, the label continues to connote an area of psychology concerned with processes such as perception, learning, motivation, emotion, and thinking. The study of *perception* (Chapters 5 and 6) is concerned with finding out how humans and animals organize and extract the information

in their environments. Understanding the manner of operation of the various receptor organs, such as the eyes, the ears, the tongue, etc., is important here, as is understanding how different creatures utilize the information provided by the receptors (see Figure 1.1).

The study of *learning* (Chapters 7, 8, and 9) makes up the largest field within experimental psychology. Of interest here is understanding how behavior changes as a result of new experiences. Many behavior changes are transient, such as those caused by fatigue, and are not included within the usual definition of learning. Others, however, are more permanent, such as the changes that occur when one learns to ride a bicycle, or to recite a poem from memory, or to bite one's fingernails, or to experience fear at being left alone in the dark. Learning psychologists are concerned with such questions as how learning is influenced by practice, the role of rewards or incentives in learning, how learning is affected by the conditions in which it occurs (e.g., the way material is presented), what happens when something is committed to memory, what is the capacity of memory, and many other questions that center about the general problem of behavior change.

Language (Chapter 10) and thinking (Chapter 11) are also studied by experimental psychologists. Together with perception and memory (Chapter 8) they constitute the "cognitive processes." Language provides for the almost infinite variety of ways in which human beings can process verbal information and communicate with one another. Its development and utilization is an area of study that is relatively new within experimental psychology. The study of thinking has a long history in psychology. It is concerned with topics such as *concept formation,* whereby one learns to use appropriately the basic, culturally agreed-upon classifications of objects, events, and their relationships. Another aspect of thinking is *problem solving,* in which a person or animal is presented with a problem, the solution of which frequently involves the internal manipulation of concepts. Thinking may be *logical,* in that the rules of logic are applied to statements, and it may be *creative,* in that new and original solutions to problems are devised.

Closely related to the problem of learning is that of *motivation* (Chapters 12 and 13), which is also a very broad area. The study of motivation ranges from a study of those internal factors which prod one to action, such as hunger, thirst, and sex, which are for the most part unlearned, to very complex motives that seem to be uniquely human and highly learned, such as the need to affiliate with other people and to achieve in the face of obstacles. Motivated behavior is usually accompanied by emotional expression; therefore, the study of emotions (Chapter 14) is usually coupled with that of motivation.

COMPARATIVE PSYCHOLOGY

Comparative psychology is the study of animal behavior. More specifically, it is the study of similarities and differences in behavior seen in animals of different species. Its history goes back to Charles Darwin's revolutionary books, *The Origin of Species* and *The Descent of Man.* Basically, the idea was developed that behavioral processes, like anatomical features, are subject

to *evolution* through the operation of *natural selection*. This notion, then, indicated that different animals might have similar behavioral processes insofar as they adapted through evolution to similar environments. Thus, it led to the study of inherited behavior patterns, or instinctive behavior. Although, as will be seen later, there are other approaches to comparative psychology, at present it can be said that the field is concerned with behavior as a biological characteristic of animals, including man. The different processes discussed under experimental psychology also apply to comparative psychology, in that perceptual, learning, motivational, and cognitive processes are frequently studied in animals, the aim being to understand these processes as biological modes of adaptation.

PHYSIOLOGICAL PSYCHOLOGY

A next-of-kin to comparative psychology, physiological psychology (Chapter 4), is also concerned with the biological aspects of behavior. There are several different approaches to physiological psychology, but all are based upon the assumption that whenever behavior occurs, bodily processes are involved, and an understanding of behavior must eventually involve an understanding of these processes. Thus physiological psychologists are concerned with the functioning of the nervous system, the endocrine glands, and various chemical processes in relation to behavior and experience.

PERSONALITY AND INDIVIDUAL DIFFERENCES

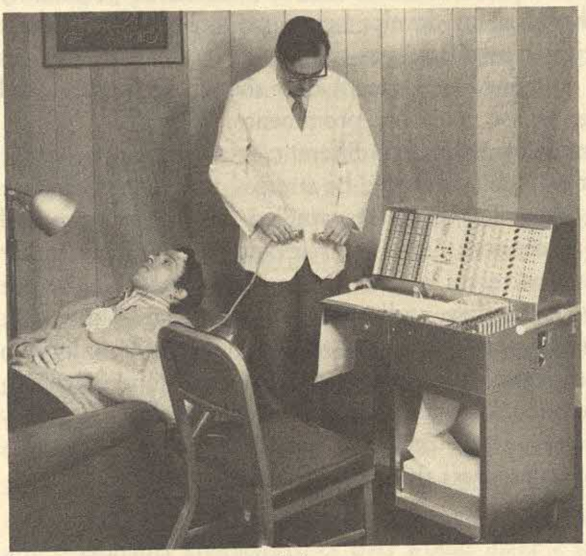
The scientific study of personality (Chapter 16) is concerned with those complex aspects of behavior and experience that differentiate one individual from another, and which play such an important role in his overall ability to get along in life. One problem within this field is *personality assessment*. What is the best system for describing a personality and for measuring individuals with respect to the system? Another problem is *personality development*. How do individuals come to be the way they are? How, and to what extent, are adult patterns learned? What role do physiological differences play in determining personality differences? The study of *personality deviations* (Chapter 17) is also important. How can the differences between

FIGURE 1.1 *Some subjects studied by experimental psychologists. (a) The obese rat got that way by overeating. It weighs about three times what a normal rat would weigh and reached its present condition because of damage to a specific region of the hypothalamus of the brain, an area which controls hunger. (b) The monkey was reared without its natural mother, but with the "surrogate" mother constructed of wire and terrycloth. The effect of maternal deprivation on later social adjustment is disastrous. (c) This subject is being prepared for an electroencephalographic recording session, in which his brain wave patterns will be recorded. (d) The boy is memorizing material presented in a memory drum, which presents material sequentially, bit by bit. (e) These gerbils are living in an "enriched" environment, at least relative to the normal laboratory cages. Animals raised in such environments show improved growth in certain areas of the brain relative to ordinary animals.*

(a) Courtesy of N. E. Miller; (b) Harry F. Harlow, University of Wisconsin Primate Laboratory; (c) Grass Instrument Company; (d) M. C. Morrow; (e) M. R. Rosenzweig.

(a)

(b)



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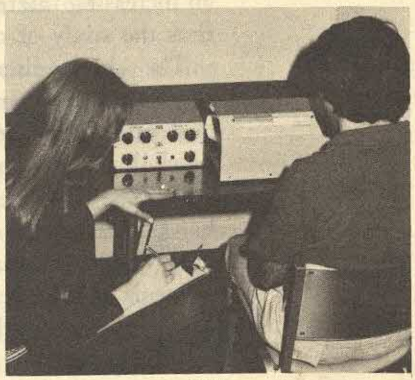

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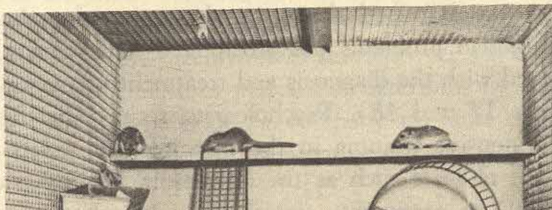


(e)

individuals be explained, especially when they are extreme, as in the case of so-called mental illness?

SOCIAL PSYCHOLOGY

Social psychology (Chapter 19) is the study of individuals in relation to other individuals. It is a very broad area that includes such problems as the way in which people perceive others, liking and disliking, helping, obedience, the forming of opinions and attitudes, persuasion, and behavior in group situations.

DEVELOPMENTAL PSYCHOLOGY

In some ways developmental psychology is closely tied in with comparative psychology, in that both fields are concerned with the evolution of behavior as a biological phenomenon. The developmental psychologist, however, focuses upon ontogenetic evolution, i.e., the evolution that takes place in a lifetime between conception and death. His task is one of explaining the changes that occur in such basic processes as perception, memory, thinking, language, motivation, emotion, and motor skills, as well as in personality and social behavior. Although many developmental psychologists are almost exclusively concerned with these changes as they occur in children, there is an increasing interest in studying development over the whole lifetime, and thus the study of old age is also achieving prominence.

The above discussion deals with the different areas within scientific psychology as separate entities, but it should be stressed that there is a great deal of overlap among them. The processes studied by the experimental psychologist—learning, perception, etc.—are relevant to all of the other areas. The way one person perceives another, for example, may on the one hand be an aspect of his personality, and on the other will no doubt affect his behavior in interpersonal situations. Understanding how children develop in terms of their ability to learn is important not only for an understanding of personality development, but also for approaching an overall understanding of the learning processes. Other interrelationships between these areas will become apparent as you progress through this course.

Applied Fields

CLINICAL PSYCHOLOGY

Although the clinical psychologist may often function as scientist in the study of personality processes as described above, he also quite often becomes directly involved in human problems. As an applied field, clinical psychology is largely concerned with the diagnosis and treatment of personality disorders (see Chapters 17 and 18). Psychologists trained in this specialty have usually had extensive training in the principles of psychological testing and in the use of tests such as the Minnesota Multiphasic Personality Inventory (MMPI), a personality test that can be taken with paper and pencil, the Rorschach ink-blot test, and various intelligence tests. (See Figure 1.2.) They have learned to administer these tests carefully and to interpret them, which takes a considerable amount of training. They have also received extensive training in psychotherapy, which is a method of treatment of personality disorders. Psychotherapy takes many forms but generally involves a close association between the therapist and the patient

over a period of weeks or months. In addition to this specialized training in *abnormal psychology* (the study of personality disorders), the clinician has also usually had rather broad training in general psychology, such as learning, perception, psychological development, etc. This training requires approximately 3 years of academic work past the bachelor's degree. Moreover, the clinical psychologist has also spent 1 year as an intern in a setting such as a psychiatric hospital or a community mental health center, where he obtains practical experience under supervision.

COUNSELING PSYCHOLOGY

Counseling psychology is quite similar to clinical psychology, in that the psychologist deals with individual people with individual problems. However, the nature of the problem is usually somewhat different. The counseling psychologist is trained to deal with people who do not necessarily have a severe personality disturbance but who need assistance in making rather difficult decisions such as the choice of a college major or a profession. His training is quite similar to that of the clinical psychologist, but he specializes in the use of tests that give a person the information he needs about himself, such as patterns of interests, special aptitudes, or problem areas (Chapters 15 and 18), in order to make intelligent decisions about his life.

INDUSTRIAL PSYCHOLOGY

As the name implies, the industrial psychologist deals with problems arising in connection with people and their work. He may be concerned with problems such as personnel selection, industrial relations, the improvement of job satisfaction and interpersonal relations within management, and a wide range of other human problems that arise in the industrial setting. The industrial psychologist is trained in general psychology but with special emphasis upon the use of psychological tests applicable in industrial settings, principles of motivation as applied to people at work, and principles of behavior in group situations. An industrial psychologist might be engaged by a company, for example, to find the right person to fill a vacancy in management. The psychologist would attempt to describe the job as accurately as possible, particularly with reference to any special talents required, and any personality characteristics that would make a person particularly suited (or unsuited) for the job. Then he would interview applicants with the aim of finding someone who matches the position. Another industrial psychologist might be hired to help smooth over some ill feelings generated within top management, or perhaps to determine by means of a well-designed survey which aspects of the company are most satisfactory or most unsatisfactory to its employees.

HUMAN ENGINEERING

One of the prominent aspects of our technological society, in addition to periodic wars and unemployment, is the increasing complexity of machines designed for human use. Inspection of the pilot's station in a large jet airplane, or of the control tower at a busy airport, will confirm the fact that machines can be very demanding on the human operator. During World War II the field of human engineering developed because of some of the problems created by the design of complex war machines. For example, how

can knobs and handles which a pilot must operate be designed so that he will not be likely to make a mistake and push or pull the wrong lever? What is the optimal amount of force to be exerted against the control stick to bank to the left or raise the nose? What is the best way to display information about the plane's position? How many dials can a pilot be expected to monitor accurately and how can they be arranged to maximize his accuracy in reading them? All of these questions concern the application of knowledge about human capabilities and limitations in perceptual and motor (i.e., overt behavior) performance to equipment design. While the human engineer is often trained as a psychologist, this is not always the case. A number of people trained in engineering find these problems challenging and interesting and become human engineers. Those who are trained as psychologists may find jobs in the field with only a bachelor's degree. Many more have stopped with the master's degree and found satisfactory work.

OTHER APPLIED FIELDS

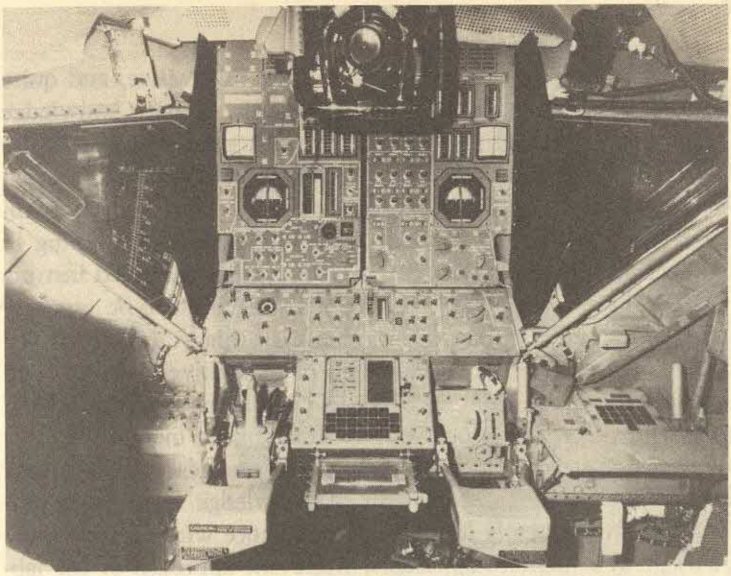
The four fields above comprise the bulk of applied psychology, but there are other areas in which psychological knowledge is applicable. For example, *community psychology* is a field that is developing rapidly. It involves the application of principles of group behavior to groups of people working within a community. Communications between factions within a community can often be facilitated by a person with skills in this area. Clinical or experimental psychologists may work within the framework of special educational programs in schools, e.g., in helping underachieving students (students whose school work is not as good as it should be, considering their abilities) attain higher levels of motivation, or in the education of mentally retarded children. Developmental psychologists may assist in the establishment of early learning centers for disadvantaged children. Comparative psychologists may find their services needed in such areas as wildlife management, or the training of animals for advertising displays.

RELATIONS BETWEEN BASIC SCIENCE AND APPLIED FIELDS

However, you should not get the idea that psychology is hopelessly divided into different interest groups. Of particular concern to many students is the distinction between basic and applied psychology. Although it is true that many psychologists consider themselves to be one or the other, but not both, there are also factors which help to bring the approaches together (Figure 1.3). First of all, many psychologists perform both functions. They spend

FIGURE 1.2 *Some situations in which applied psychologists operate. (a) The lunar module. The controls and displays were carefully designed with the help of human engineers so that the pilots would be able to perform with the most efficiency and the fewest possible mistakes. (b) A group therapy situation. People can learn a lot about themselves and other people in a small group under the leadership of a trained psychologist. (c) This girl is working with programmed instruction, which is an outgrowth of research in principles of human learning. (d) Individual psychotherapy.*

(a) National Aeronautics and Space Administration; (b) M. C. Morrow; (c) Prentice-Hall, Inc., Englewood Cliffs, N.J.; (d) M. C. Morrow



(a)

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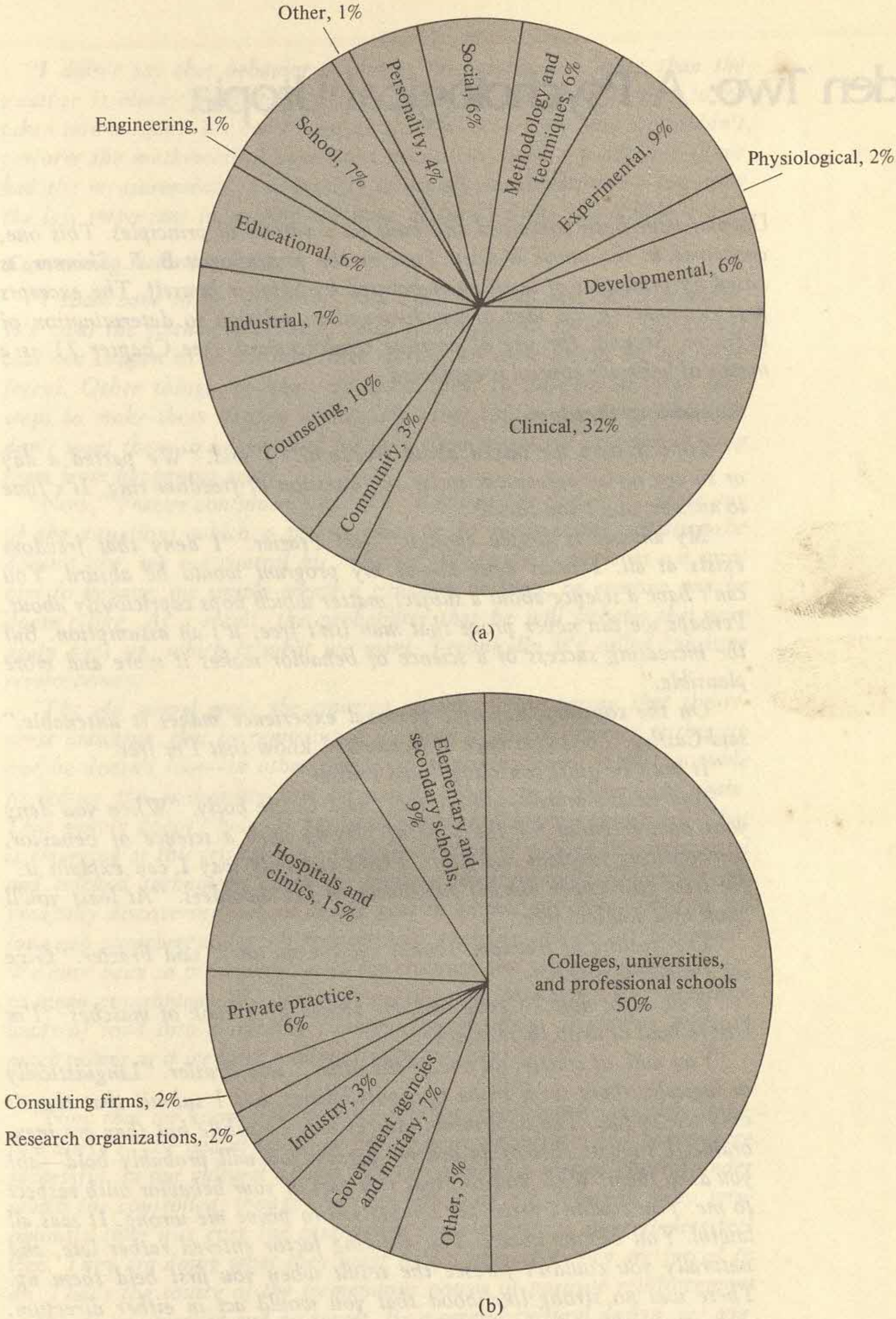
part of their time in research, and part of their time in practice, and quite frequently develop an appreciation for both approaches. Second, knowledge derived from basic psychological research is frequently used by applied psychologists. For example, a form of therapy known as behavior modification therapy (see Chapter 18) was a direct application of principles of conditioning and learning (Chapter 7) derived from basic studies of learning in humans and animals. These same principles have led to programmed instruction that many would argue is more effective than the usual type of classroom instruction. The work of the Swiss psychologist Piaget (Chapter 11) has had a great influence upon the development of innovative approaches to primary school education. The relation between human engineering and the study of sensory and perceptual processes has already been mentioned.

On the other hand, a psychologist faced with a practical problem may have to make decisions without the benefit of knowledge from basic psychology. This situation frequently leads to an impatience with the relatively painstaking, slow, and sometimes apparently irrelevant approach of the laboratory scientist, and a tendency on the part of some applied psychologists to deny the usefulness of the basic areas at all for the practice of psychology. In response to this criticism it can be said that quite often the applied psychologist has, perhaps without knowing it, gained an understanding of behavior that he would not have without the laboratory approach. Of more basic importance is the fact that both clinicians and researchers require skills that go beyond what they have learned in psychology. In both fields practical approaches to problem solving based on life experiences are necessary.

Science and Humanism

The previous discussion focused upon what psychologists as scientists and as professionals *do,* and the implication was that the scientific conception of behavior will ultimately provide professionals with the theoretical framework and specific information they need to do their work. You should be aware, however, that not all psychologists would agree with this analysis. Indeed, you are probably familiar with the general antiscientific attitude that has developed over the last several years, a development which is sometimes coupled with an increased interest in occult phenomena, mysticism, astrology, and fortune telling. This movement has had its impact on psychology as well as on other fields of study.

The primary force within psychology that opposes the scientific conception of human behavior is a movement known as humanistic psychology. The argument is advanced that human beings are unique and, furthermore, that each human being is unique. Science attempts to develop general laws applying to all people, or all organisms, which, the humanists argue, tends to deemphasize what is most important about man—his uniqueness. For the humanist it is somehow dehumanizing to explain a person's behavior and experience in terms of general theoretical principles. It is, on the other



(a) The percentage of psychologists specializing in various fields; (b) the percentage of psychologists employed in various capacities. 1972 Data from the American Psychological Association Manpower Data System.

FIGURE 1.3

Walden Two: A Psychological Utopia

Utopias have been conceived and built on a variety of principles. This one, conceived in the novel Walden Two by the psychologist B. F. Skinner, is based on principles of learning elaborated by Skinner himself. The excerpts first expound on the idea of freedom and its relation to determination of behavior. Second, the use of positive reinforcement (see Chapter 7) as a means of behavior control is explained.

Concerning Freedom

"Isn't it time we talked about freedom?" I said. "We parted a day or so ago on an agreement to let the question of freedom ring. It's time to answer, don't you think?"

"My answer is simple enough," said Frazier. "I deny that freedom exists at all. I must deny it—or my program would be absurd. You can't have a science about a subject matter which hops capriciously about. Perhaps we can never prove that man isn't free; it's an assumption. But the increasing success of a science of behavior makes it more and more plausible."

"On the contrary, a simple personal experience makes it untenable," said Castle. "The experience of freedom. I know *that I'm free."*

"It must be quite consoling," said Frazier.

"And what's more—you do, too," said Castle hotly. "When you deny your own freedom for the sake of playing with a science of behavior, you're acting in plain bad faith. That's the only way I can explain it." He tried to recover himself and shrugged his shoulders. "At least you'll grant that you feel *free."*

"The 'feeling of freedom' should deceive no one," said Frazier. "Give me a concrete case."

"Well, right now," Castle said. He picked up a book of matches. "I'm free to hold or drop these matches."

"You will, of course, do one or the other," said Frazier. "Linguistically or logically there seem to be two possibilities, but I submit that there's only one in fact. The determining forces may be subtle but they are inexorable. I suggest that as an orderly person you will probably hold—ah! you drop them! Well, you see, that's all part of your behavior with respect to me. You couldn't resist the temptation to prove me wrong. It was all lawful. You had no choice. The deciding factor entered rather late, and naturally you couldn't foresee the result when you first held them up. There was no strong likelihood that you would act in either direction, and so you said you were free."

"That's entirely too glib," said Castle. "It's easy to argue lawfulness after the fact. But let's see you predict what I will do in advance. Then I'll agree there's law."

"I didn't say that behavior is always predictable any more than the weather is always predictable. There are often too many factors to be taken into account. We can't measure them all accurately, and we couldn't perform the mathematical operations needed to make a prediction if we had the measurements. The legality is usually an assumption—but none the less important in judging the issue at hand" [pp. 257–258].

Concerning Behavior Control

"I shall have to be technical," said Frazier. "But only for a moment. It's what the science of behavior calls 'reinforcement theory.' The things that can happen to us fall into three classes. To some things we are indifferent. Other things we like—we want them to happen, and we take steps to make them happen again. Still other things we don't like—we don't want them to happen and we take steps to get rid of them or keep them from happening again.

"Now," *Frazier continued earnestly, "if it's in our power to create any of the situations which a person likes or to remove any situation he doesn't like, we can control his behavior. When he behaves as we want him to behave, we simply create a situation he likes, or remove one he doesn't like. As a result, the probability that he will behave that way again goes up, which is what we want. Technically it's called 'positive reinforcement.'*

"The old school made the amazing mistake of supposing that the reverse was true, that by removing a situation a person likes or setting up one he doesn't like—in other words by punishing him—it was possible to reduce *the probability that he would behave in a given way again. That simply doesn't hold. It has been established beyond question. What is emerging at this critical stage in the evolution of society is a behavioral and cultural technology based on positive reinforcement alone. We are gradually discovering—at an untold cost in human suffering—that in the long run punishment doesn't reduce the probability that an act will occur. We have been so preoccupied with the contrary that we always take 'force' to mean punishment. We don't say we're using force when we send shiploads of food into a starving country, though we're displaying quite as much* power *as if we were sending troops and guns."*

"Now that we know *how positive reinforcement works and why negative doesn't," he said at last, "we can be more deliberate, and hence more successful, in our cultural design. We can achieve a sort of control under which the controlled, though they are following a code much more scrupulously than was ever the case under the old system, nevertheless* feel free. *They are doing what they want to do, not what they are forced to do. That's the source of the tremendous power of positive reinforcement—there's no restraint and no revolt. By a careful cultural design, we control not the final behavior, but the* inclination *to behave—the motives, the desires, the wishes.*

"The curious thing is that in that case the question of freedom never

arises. *Mr. Castle was free to drop the matchbook in the sense that nothing was preventing him. If it had been securely bound to his hand he wouldn't have been free. Nor would he have been quite free if I'd covered him with a gun and threatened to shoot him if he let it fall. The question of freedom arises when there is restraint—either physical or psychological . . ." [p. 262].*

hand, elevating to attempt to understand completely an individual human being.

This controversy between science and humanism promises to be a major source of contention within psychology in the next few years. You will encounter from time to time in this book references to the two approaches, particularly in relation to personality and psychotherapy. While one may hope the developing dialogue will be productive of growth rather than stagnation, at this point it is difficult to predict the outcome.

A Brief History of Psychology

Psychology, it has been said, has a long past and a short history. Some of the problems with which psychology deals in one way or another have been considered by generation after generation of philosophers, going back at least to the Greeks who lived before Aristotle's time (ca. 350 B.C.) Questions about the nature of the intellect, the components of the mind, the relation between the mind and the body, the way in which we acquire knowledge, and how associations between events (e.g., lightning and thunder) are formed have interested intelligent men for a long time. While modern psychology would tend to phrase these questions differently, many are still with us and of interest to psychologists. For example, instead of discussing the mind-body problem, psychologists now are concerned with relationships between the brain and behavior. The problem of the source of knowledge and the formation of associations have become the problems of the psychology of perception and learning. Questions concerning the nature of the intellect have been translated into questions about the abilities and aptitudes that comprise intelligence. The main difference between antiquity and modern times is the approach to the problems and the way they are phrased, not the problems themselves. The scientific approach as applied to behavior and experience will be described in more detail in Chapter 2.

In terms of its most recent history, psychology can trace its beginnings back to several developments in postrenaissance philosophy and in biology and medicine. One important development in philosophy was the *mechanistic* concept that the body was a very complicated machine obeying physical laws. This view ran counter to another view, *vitalism,* that life could not be explained solely in terms of physical principles but, rather, existed by virtue of some vital force which was not subject to physical laws.

Adoption of the mechanistic approach permitted scientists to approach biological and psychological questions with the hope of achieving answers in physical terms, and thereby was important in stimulating research into these problems. The idea that the body is a machine was given prominence by René Descartes (1596–1650) and then taken up and extended to the mind itself by later philosophers. The notion that the mind is a machine—that mental processes run off rather automatically—led quite naturally to modern conceptions of behavior as a bundle of reflexes put together in various ways and thus to the study of *conditioned reflexes* (Chapter 7).

Another important development was *empiricism,* the philosophy which specifies that all knowledge comes from the senses, and *associationism,* which asserts that complex ideas are the result of the association or combination of simpler components. These ideas were in opposition to *nativism,* or the notion that some ideas are innate and exist prior to one's experience. The empiricist philosophy was important in stimulating interest in the study of perceptual processes and learning, since they would presumably be the ultimate source of all knowledge. Both perception and learning constitute a large portion of experimental psychology today.

A major thrust toward the development of psychology occurred in biology and medicine. These fields were developing quite rapidly during the nineteenth century, and a number of events presaged psychology as an independent discipline. The importance of Darwin's theory of evolution for the development of comparative psychology has already been mentioned. Of great importance was the increasingly obvious fact that the body could be studied with the tools of science, and that its functioning could be explained in terms of physics and chemistry. Among the aspects of bodily functioning studied were the functioning of the senses. The famous physicist and physiologist Hermann von Helmholtz, for example, developed a theory of color vision and a theory of how auditory receptors function. These theories were quite influential and, in some respects, are reasonably adequate today. Helmholtz's teacher, Johannes Muller, stated very explicitly the relationship between the activity of nerves and the experiences of seeing, hearing, etc. The physicist Fechner attempted to show that sensations could be measured (i.e., mental events could be quantified). Later work by anatomists and physiologists showed that different psychological functions seemed to "reside" in different areas of the brain. In summary, it became quite clear that at least certain psychological processes were in fact manifestations of bodily processes, which in turn could be studied and understood using the scientific approach, and without even mentioning concepts such as the mind.

These developments in philosophy, biology, and medicine, then, set the stage for the emergence of psychology as an independent discipline, in that they pointed toward the idea that behavior and experience—manifestations of mental functioning—could be studied systematically. (See Figure 1.4.) All that was left was for someone to call himself a psychologist, and that person was Wilhelm Wundt (1832–1920).

Wundt established the first psychological laboratory in the world at the University of Leipzig in 1879. In his laboratory were trained many of the

(a)

(b)

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FIGURE 1.4 *Individuals who were influential in the development of modern psychology (a) Hermann von Helmholtz, (b) William James, (c) Wolfgang Köhler, (d) Ivan Pavlov, (e) Herman von Ebbinghaus. (a)–(c) The Granger Collection; (d) National Library of Medicine; (e) The Bettman Archive.*

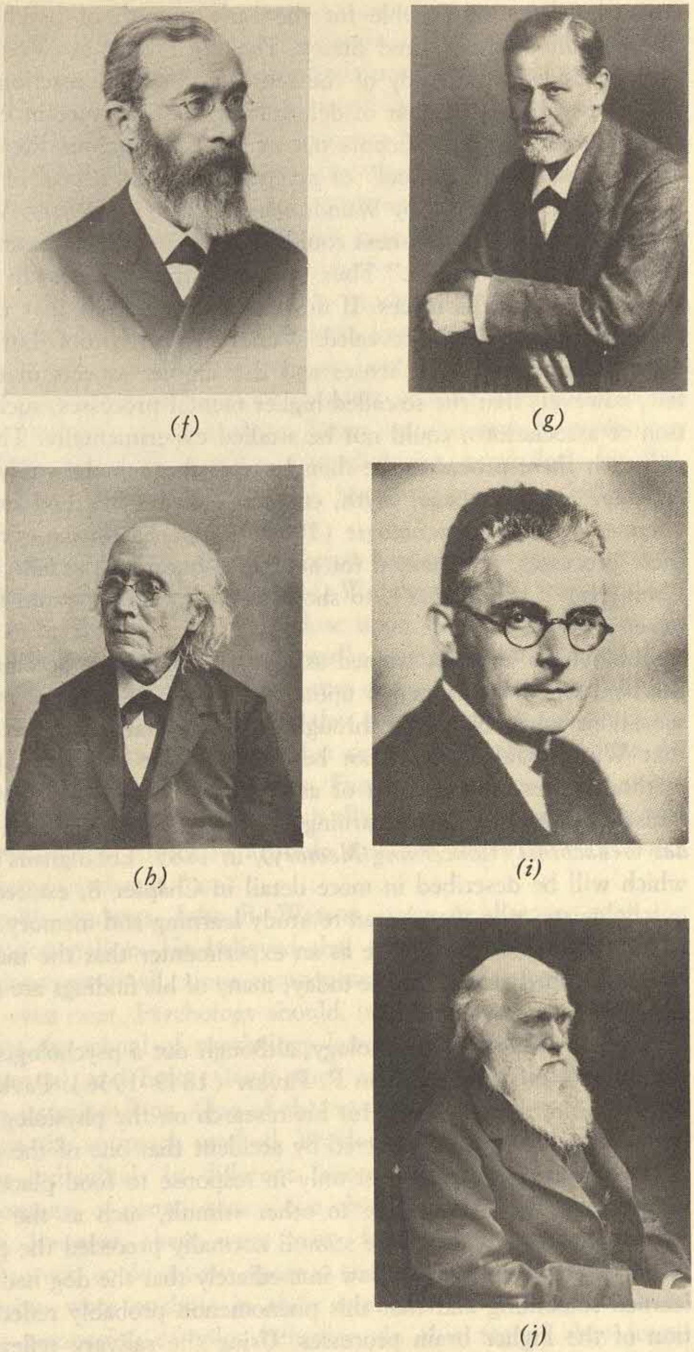

FIGURE 1.4 *Individuals who were influential in the development of psychology. (f) Wilhelm Wundt, (g) Sigmund Freud, (h) G. T. Fechner, (i) John B. Watson, and (j) Charles Darwin. (f), (g), (h), (j), The Bettman Archive; (i) Historical Picture Service (Chicago).*

men who were responsible for the early growth of psychology, both in Europe and in the United States. The great bulk of Wundt's work was concentrated on the study of the senses and simple reactions. He saw the task of psychology as that of determining the structure of consciousness—i.e., determining the elements out of which conscious life was composed For this reason the "school" of psychology (i.e., a school of thought about psychology) developed by Wundt was called *structuralism.* Wundt felt that the contents of consciousness could best be studied by means of *introspection,* or "looking within." Thus he would train subjects to introspect and report on their experiences. If done carefully, he felt that the elements of consciousness would be revealed. Wundt's research contributed a great deal to knowledge about the senses and the simpler aspects of experience. He felt, however, that the so-called higher mental processes, such as the formation of associations, could not be studied experimentally. The only way to approach these processes, he thought, was through the study of "Folk psychology," i.e., language, myth, custom, etc. To this end he produced 10 volumes of *Volkerpsychologie* (1900–1920). As for experimentation with these processes, it remained for another pioneer in the field, Hermann von Ebbinghaus (1850–1909), to show that associations could be studied systematically.

Ebbinghaus was not trained as a psychologist but became interested in the field when he happened upon Fechner's book on the measurement of sensations while browsing through the book stalls of Paris. Not knowing that Wundt said it could not be done, he set about to apply Fechner's method to the measurement of associations. After several years of testing himself in various tests of learning and memory, he published a book, *Ueber das Gedachtnis (Concerning Memory),* in 1885. Ebbinghaus's contribution, which will be described in more detail in Chapter 8, excited a number of psychologists, who then began to study learning and memory. It is a tribute to his thoroughness and care as an experimenter that the methods Ebbinghaus developed are still in use today; many of his findings are still considered valid.

Another founder of psychology, although not a psychologist himself, was the Russian physiologist Ivan P. Pavlov (1849–1936). Pavlov had already achieved international fame for his research on the physiology of the digestive system. Then he discovered by accident that one of the gastric reflexes he was studying occurred not only in response to food placed in the dog's mouth, but also in response to other stimuli, such as the experimenter's coming into the room. These stimuli normally preceded the placing of food in the dog's mouth. Pavlov saw immediately that the dog had in some sense learned something and that this phenomenon probably reflected the operation of the higher brain processes. Using the salivary reflex, he began to investigate these *conditional reflexes* more systematically, and thus began what is now known as the study of *classical conditioning* (see Chapter 7).

Another important contributor to the early development of psychology was Sigmund Freud (1856–1939). Freud was trained as a medical researcher and then became a neurologist—one who specializes in diseases

of the nervous system. He later became interested in personality disturbances and, through the information he obtained while treating his patients, he developed a theory of personality that has had a profound influence on psychology. This theory will be discussed more fully in Chapters 16–18, but, basically, it stresses the determination of behavior by unconscious processes, i.e., processes of which the person is not aware, and the extreme importance of early experience as a determinant of later adult behavior.

In the United States the first psychologist was William James who, like Freud, was trained as a physician. James, however, taught physiology at Harvard, where he became interested in the study of psychology. His laboratory was established at about the same time as Wundt's although Wundt's is usually given precedence because James's laboratory was not a "self-conscious" laboratory of psychology. After writing a very influential textbook, *The Principles of Psychology,* James lost interest in psychology and became a philosopher. His work as a psychologist, particularly his ability to synthesize developments in the field, however, was quite influential, and his textbook is still worth reading today.

After its early start, psychologists soon began grouping themselves according to the approach they took to the field. Wundt's school, structuralism, has already been mentioned. Following close upon Wundt's heels was the school of *functionalism,* more or less formally established by the psychologist James Rowland Angell, but with a great deal of influence by William James and John Dewey. Angell proposed that psychology should study the adaptive aspects of consciousness, i.e., what does consciousness *do for* the organism, or what *function* does it serve. Functionalism flourished at the University of Chicago and is still very much alive today. You might say that it epitomizes the typical American attitude that the importance of something is to be found in what it *does.*

One of Angell's students, John B. Watson, came to disagree with the principles of functionalism. He believed that psychology had no business studying consciousness at all, since conscousness was not observable, and maybe did not even exist. Psychology should, instead, study behavior. Thus Watson founded the school of psychology known as *behaviorism.* He was extremely influential, and before long much of American psychology was behavioristic in its orientation. One of the reasons for the success of behaviorism was that the approach worked. Previously, there were many arguments between individuals in different laboratories about, for example, exactly what contents of consciousness one obtained when he introspected. With behavior, however, there were many fewer arguments, since two independent observers could usually agree as to what happened in an experiment. Behaviorists were analytic in their approach, attempting to determine the units composing complex behavior. In this regard they found Pavlov's conditioned reflexes much to their liking, and at one time Watson suggested that all behavior could be explained as combinations of conditioned reflexes.

Another school of psychology developed in Germany at about the same time that behaviorism developed in the United States. That school, known

as *Gestalt psychology,* was founded by the psychologist Max Wertheimer. Two other psychologists, Wolfgang Köhler and Kurt Koffka, very quickly became associated with Wertheimer. These men objected to the analytic approach of the structuralists as well as the behaviorists. They felt that both behavior and experience were "wholes," which had properties that were not necessarily equal to the sum of the elements comprising them. Thus they thought that analysis caused one to lose sight of the essential whole-character of the phenomena. The research of the Gestalt psychologists focused upon perception, although they also made a number of contributions to the study of learning and problem solving.

A few years later the energies devoted to promoting particular schools of psychology became more narrowly channeled, at least in American psychology, into the development of different "theories of learning," i.e., conceptions of how learning was to be understood. Some of these approaches will be discussed later in Chapter 7. As you will see there, many of these theoretical issues have in turn died out because of lack of interest or productiveness.

The present may perhaps be characterized by a developing dialogue between a modern version of the behavioristic approach and the emerging cognitive approach that has already been mentioned. The form of the dialogue concerns whether it makes more sense to limit one's consideration strictly to behavior that can be observed or to develop techniques (ultimately using behavior, of course) for making indirect references about mental processes.

Psychologists today are also becoming more eclectic. There is a tendency to focus upon particular problems and to develop techniques appropriate to their solution, rather than spend a great deal of time arguing about what psychology is or is not, should or should not be, can or cannot study. The journals that at one time were strongly behavioristic in orientation are now publishing articles about the perceptual experience of subjects and about investigations of mental processes. In other words, it appears that psychology is finally getting down to the business of determining its methods and subject matter on the basis of fairly broad criteria of workability and fruitfulness, rather than on the basis of a priori edicts. What this approach will lead to, of course, is a matter for future psychologists to decide.

Summary

Psychology is both a science and a profession. As a science, it is the study of behavior and experience. Behavior is what an organism does and may be studied at the molecular or the molar level. Behavior is usually observable and is therefore the focus of interest for much of psychology. Subjective experience is private and therefore unobservable except indirectly, through

some kind of overt behavior. It is more difficult to study than behavior but constitutes an important focus of interest for many psychologists. The fields of scientific psychology include experimental psychology (perception, learning, motivation, emotion, thinking); comparative psychology and the study of animal behavior; physiological psychology; and personality psychology, social psychology, and developmental psychology.

Professionals working in applied fields include clinical, counseling, industrial, and engineering psychologists. There are also a few other more specialized applications of the scientific areas, including community psychology and applied child psychology.

Historically, psychology developed from roots in philosophy, especially empiricism and associationism. It also has roots in biology and medicine, in which the study of the sense organs and the nervous system paved the way for early psychological studies of sensation and perception. The first psychological laboratory was established in 1879 at Leipzig, Germany, by Wilhelm Wundt, who founded the school of thought known as Structuralism. Wundt's aim was to study the structure of mental life through the use of introspection. Other schools of psychology included Gestalt psychology, founded at Berlin by Max Wertheimer, Kurt Koffka, and Wolfgang Köhler: Functionalism, founded in America by John Dewey and James R. Angell, but with many contributions by William James; and Behaviorism, founded by John B. Watson. Other individuals of importance in early psychology were Ivan Pavlov, who discovered classical conditioning, a form of learning; Sigmund Freud, the founder of psychoanalysis; Hermann Von Ebbinghaus, who made the first studies on human verbal learning; and G. T. Fechner, who showed that measurement could be applied to sensations.

Modern day psychology seems less inclined to divide itself into schools, and individual psychologists with different points of view seem somewhat better able to learn from each other.

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Goals and Methods of Psychology

2

Psychology, like biology, physics, and medicine, is a rather large enterprise, involving many thousands of people. As you have seen in Chapter 1, it is quite diverse, encompassing both practical and applied interests such as clinical and industrial psychology, and basic research interests as are found in experimental psychology. You may wonder whether it is possible to characterize such a heterogeneous field by any common set of goals. Many psychologists wonder the same thing, and the concept of psychology as a single discipline is questioned from time to time. On the other hand, it is possible to distill from the varied programs of different psychologists at least three goals that most of them seem to have in common. These goals are *prediction, control,* and *understanding.*

The Aims of Psychology

Prediction

Prediction is hardly unique to psychology. Everybody makes predictions of one sort or another, and most people wish their predictions were more accurate. Bettors at horse races and football games would like to be able to make better predictions of performance. Politicians hire pollsters to help improve their ability to predict how voters will react to certain issues. College admissions officers try to predict whether a student will be successful or not, and personnel managers try to predict how well a prospective employee will do in a job. You can probably think of many more examples, and you will note that most of them are instances of prediction of *behavior.*

Prediction is possible only if, as scientists must assume, the phenomena in which they are interested are *lawful,* i.e., the phenomena are considered to be organized according to general principles. (The principles, of course, may

have to be discovered; the scientist must assume that if he goes about his business in the right way, they *will* be discovered.) Another important related assumption is that of *determinism.* That is, it is assumed that natural events are the result of causes which are discoverable. Some people have trouble accepting this assumption about behavior, particularly human behavior, since it appears to conflict with the notion of *free will.* Whether or not you wish to accept this assumption in relation to your own life, if you wish to approach behavior scientifically, you will probably have to be prepared to act as though you accept it, at least during working hours. Otherwise, investigations as to the causes of behavior would make no sense at all.

Prediction of behavior also requires *knowledge.* Knowledge in science is organized in the form of *theories,* which you will see more of later. At this point simply remember that to predict behavior you must know something about the organism whose behavior you are predicting and the situations in which the behavior is to occur.

CLINICAL PREDICTION

Actually, there are two kinds of prediction in psychology, clinical and actuarial. *Clinical prediction* is about the behavior of an *individual.* In accepting a blind date you may, for instance, want to find out something about the person in order to enable you to predict his or her behavior on the date. Probably, you would really not be interested in predicting all the specifics of behavior. You would, however, want to be able to predict whether he or she would, for example, do something extremely obnoxious or dangerous. In other words, probably without being aware of it, you involve yourself in clinical prediction of the *limits* of behavior every day.

When a firm, particularly a small one, hires a new employee, the boss or the personnel manager engages in clinical prediction, asking himself whether or not the prospective employee will perform well at his job. The counseling psychologist makes clinical predictions about a student in terms of how happy he will be in particular occupations or how difficult it will be for him to major in a particular subject or learn a particular job. A clinical psychologist conducting a diagnostic interview would like to be able to predict whether the interviewee will be able to stick to his goals, have a happy marriage, find a satisfying occupation, and, in general, adjust well to adult life. Clinical prediction is also seen in the use of horoscopes, palm reading, crystal ball gazing, and other spiritualistic practices. In the second section of this chapter we shall try to differentiate between these latter kinds of spiritualistic prediction and "legitimate" psychological prediction on the basis of the methods and knowledge underlying them.

ACTUARIAL PREDICTION

Actuarial prediction focuses upon the behavior of *groups* of individuals, and the individual himself is of less importance. What is predicted is the group tendency, or average, and individuals are of importance only insofar as they contribute to the group tendency. Several examples of actuarial prediction follow.

For various theoretical reasons, which need not be elaborated now, the hypothesis was tested that lower class and middle class parents would differ

in terms of the kind of punishment used on children. The prediction was that lower class individuals would use more physical punishment (e.g., beating), while middle class individuals would use more psychological punishment (e.g., scolding, withdrawing of love, appealing to one's "moral sense," etc.). The predictions were borne out in several studies, in that there was a tendency for more physical punishment to be used in lower class homes, and more psychological punishment in middle class homes. The point is that there were *some* lower class parents who used psychological punishment and *some* middle class parents who used physical punishment, in contradiction to the hypothesis. However, *on the average,* the tendency that was predicted was the one that was found. In other words, in terms of actuarial prediction, the relatively few exceptions do not invalidate the general rule, which simply states that if you make a large number of observations, you will find that more physical punishment is used in lower class homes, etc.

The Dean of Admissions in your college is faced with the problem of admitting those individuals who seem likely to succeed, i.e., make high enough grades to graduate (Figure 2.1). College Board scores and high school grades are often used to help make the prediction. On the basis of experience with previous classes of students at that college, mathematical equations can be developed which predict, for that college, the chances of success for individuals with particular College Board scores and high school grades. For instance, he may find that, of the people who scored below, say, 400 on the College Boards, only one in ten made high enough grades to stay in school. On the basis of this previous experience, then, he would say that, if a person scored below 400 on the test, his chances were one in ten that he would be able to stay in school. Such a prediction is an actuarial prediction because it makes a statement about a group tendency—in this case the tendency of a certain proportion of the *group* of individuals scoring below 400 not to succeed in college. Obviously, the individual either is or is not going to succeed. He will either stay in or flunk out. He cannot stay one-tenth in and nine-tenths out. The dean may decide to admit him in spite of his low score because he has other information which leads him to believe that he will succeed, or maybe he is the son of the college president. In either case, his decision about the *individual* is a *clinical* decision, based on *clinical prediction.* His predicton of the *average performance* of the *group* of low scorers, however, is an *actuarial prediction.*

There are numerous other examples of actuarial prediction in psychology, particularly in the basic science fields. An experiment on the effects of motivation on performance in a maze may compare the behavior of two groups of rats, one of which had been deprived of food for 24 hours and the other of which had just eaten. Individuals within the groups may be expected to vary somewhat in their performance, since some rats do better than others in mazes. The focus of interest, however, is on the tendency of the two groups, often expressed in terms of the *average* performance.

You will run across many other examples of actuarial prediction as you read this book. The main point to remember is that *actuarial prediction is concerned with group averages and is only incidentally interested in the*

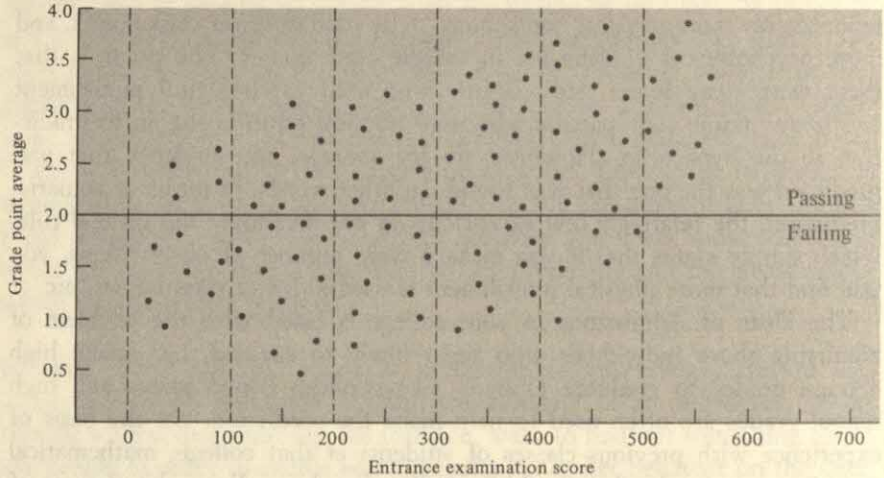


FIGURE 2.1 *A college admissions problem. Put yourself in the position of the Dean of Admissions. The data shown in the graph were obtained on 110 students the previous year and are considered typical. On the X axis (horizontal) you see the scale for a college admissions test, and on the Y axis (vertical) you see grade point average with 2.0 (C) being required for graduation. Each point, then, represents a particular student's admission score and grade point average. Your problem is to decide where to establish the cut-off point for admission. You know (1) that a certain minimum number of students must be admitted, for budgetary reasons; (2) the number of failures should be minimized, for reasons of morale and public relations; and (3) the number of students who are rejected but who might have passed had they been admitted should be minimized. Where should the cutoff point be?*

individual case. Clinical prediction is concerned with the behavior of the individual. Both types of prediction are of great importance in psychology.

Control

Psychologists also see as a goal of their activities the control of behavior. Unfortunately, the term control carries with it a meaning which, when applied to psychology, leaves one with the impression that psychologists are attempting to "pull the strings" and cause us to do things that they want but that we might not choose. While some individuals, both psychologists and nonpsychologists, may have this end in mind, the institution of psychology is not aimed in that direction. Control, when considered as a goal of psychology, can best be explained with a few more examples.

Engineering psychologists are concerned with the design of equipment so

that it can be used effectively by human operators. For example, the task of a pilot of a large aircraft is quite complex at times, and he must use his vision, hearing, and tactile senses sometimes simultaneously. A number of levers, knobs, and handles must be used, often without benefit of vision (Figure 2.2). Consequently, it is important that he be able to select the different handles on the basis of felt shape alone. Psychologists have assisted in the design of variously shaped handles so that people can easily tell them apart by touch alone. The point is that by designing the equipment appropriately, taking into account the capabilities and limitations of the human operator, the operator's behavior is thereby *controlled,* and, in this case, made more effective. There are numerous other examples from engineering psychology in which behavior is controlled by designing equipment in accordance with what we know about human beings.

Clinical psychologists attempt to control the behavior of their clients by the use of various psychotherapeutic techniques (see Chapter 18). A client comes to a psychologist for various reasons, often involving problems with which he feels powerless to deal. By helping him to deal with his problems more effectively, the therapist is in some sense controlling the client's behavior.

A number of psychologists are interested in how people learn and in applying what they know with the aim of making learning easier. You, as a student, would probably welcome some procedure that would take the agony out of learning a new language or differential equations. One technique that has been devised, and which seems to work in some cases, is programmed instruction (Figure 1.2. See Chapter 7). The progress of the

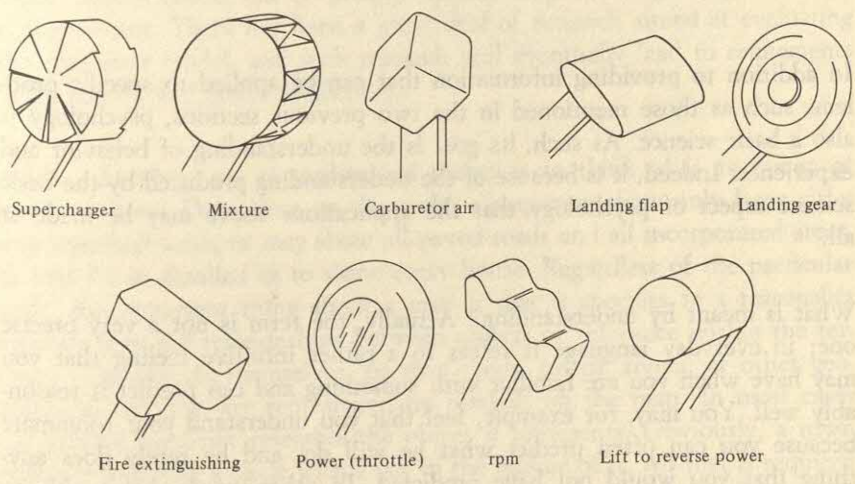


FIGURE 2.2

These knobs were designed to control the pilot's behavior. They are standard for U.S. Air Force planes. The shapes can be discriminated easily by touch alone, and some of them, e.g., the flaps and landing gear controls, resemble that which is controlled.

From Personnel Subsystems, *AFSCDH 1-3 56, Chap. 2, Sec. 2D18, p. 3, United States Air Force Systems Command.*

learner is controlled (1) by taking small steps so as to minimize the possibility of mistakes, (2) providing immediate knowledge of results (i.e., information as to how one is doing), and (3) giving the learner the option of proceeding at his own pace. Thus the progress of the learner is controlled by controlling the design of the learning task.

The laboratory scientist is also concerned with control. For example, an investigator interested in memory might perform experiments in order to determine the factors that control how well a person can remember a list of words. He may find that material which is emphasized in some way to make it distinctive is remembered better than other material. Thus he would conclude that distinctiveness is a factor controlling memory, or, to put it differently, memory depends upon distinctiveness. By being able to make such a statement, the scientist, in fact, understands the phenomenon of memory better. In other words, when you understand something, you can control it. Indeed, to continue the example, you could then set up the conditions so that either a high or a low score on a memory test could be obtained, i.e., you could manipulate memory.

In all of the above situations you can see that behavior is in some way controlled by the application of psychological knowledge. You have also probably noted that these are situations in which behavior is typically controlled by someone, whether by the application of psychological principles or not. In other words *someone* must, for *some* reasons, make decisions and carry out actions that control someone else's behavior. One goal of the psychological enterprise is to learn enough about behavior to make it possible for such control to be exercised in an effective and humane manner.

Understanding

In addition to providing information that can be applied to specific problems such as those mentioned in the two previous sections, psychology is also a basic science. As such, its goal is the understanding of behavior and experience. Indeed, it is because of the understanding produced by the basic science aspect of psychology that the applications above may be made at all.

FROM PREDICTION AND CONTROL

What is meant by understanding? Actually, the term is not a very precise one; in everyday language it refers to a rather intuitive feeling that you may have when you are familiar with something and can predict it reasonably well. You may, for example, feel that you understand your roommate because you can often predict what he will do, and he rarely does anything that you would not have predicted. In other words, being able to predict is evidence of understanding. You may get the same feeling when you are able to control some person or thing. Lion tamers may feel that they understand lions because they can control their behavior (most of the time). Thus, being able to control is also evidence of understanding.

THEORY

Ordinarily, understanding as applied to scientific activity goes farther than simply being able to predict and control intuitively, although this ability may lead to important discoveries that may then be understood in a more explicit way. Scientific activity is actually aimed at producing *theory*. A theory is a relatively abstract conceptualization of events that (1) groups them in some way so that different events are related to one another, (2) indicates the nature of the relationship between the events, and (3) enables you explicitly to predict events through the logical process of deduction.

Models. Another term often used in this context is *model*. An airplane model is a replica of an airplane. If the replica is sufficiently precise, you can predict how the "real" airplane would behave in various circumstances through the use of a wind tunnel. Prediction is not perfect, however, since the model is not the actual airplane and, in this example, physical size makes a big difference. In psychology there are models of various psychological processes. These models are not physical replicas of the processes but are more abstract. The models are composed of terms that the investigator feels represent the essential elements of the psychological process under consideration, much as a model airplane is composed of wings, fuselage, horizontal stabilizer, rudder, etc.—parts whose relationships to one another differ for different airplanes. An example of a model in psychology is one developed in order to understand memory. This model is described on p. 36. If the terms and their relationships accurately reflect what goes on in the process of storing and retrieving information, then the model should enable one to predict remembering and forgetting in various circumstances. There has been a great deal of research aimed at evaluating the computer model, and such research will eventually lead to refinements in the models and better predictions.

Maps. Another way to understand theory is to think of it as a *map* of some territory. Depending on the scale, a map may show only large cities and superhighways, or may show all paved roads and all incorporated areas, or may be so detailed as to show every house. Regardless of the particular scale, the important thing about a map is that it specifies in a reasonably accurate way the relationships between objects of relevance within the territory. The objects themselves, be they roads, towns, rivers, or other geographical features, are represented by *symbols* on the map. In most cases the symbol need not resemble the object it represents. Obviously, a town does not look like a circle with a dot in the middle of it. All that is required is that the *relationships* be accurate enough for you to use the map to get from one place to the next. The same may be said for theories and models in psychology. The concepts in a theory or a model need not *resemble* the phenomenon of interest. All that is required is that the *relationships* between the concepts be reasonably precise. Thus one might say that a goal

A Model of Memory

What is memory? It is clear that some understanding of how one's past experience affects one's present behavior is quite important, and the special problem of how we are able to recall or reconstruct a series of past events, or to recognize a familiar face, tune, street, etc., has occupied psychologists ever since there was a psychology. (See Chapter 8.)

It is often helpful in attempting to understand a phenomenon if one can construct a model *expressing some of the known aspects of the phenomenon. Then the various elements in the model can be manipulated, shifted around, etc. The outcome of such manipulations can be examined and then checked against actual behavior.*

Several models for the memory process have been proposed. One recent model (Shiffrin & Atkinson, 1969) is based on the fact that, in many respects, human memory seems to function like the memory of a digital computer. The basic idea is that information is transferred from one to another component in the memory system, eventually winding up in long-term store, from which it may be retrieved later.

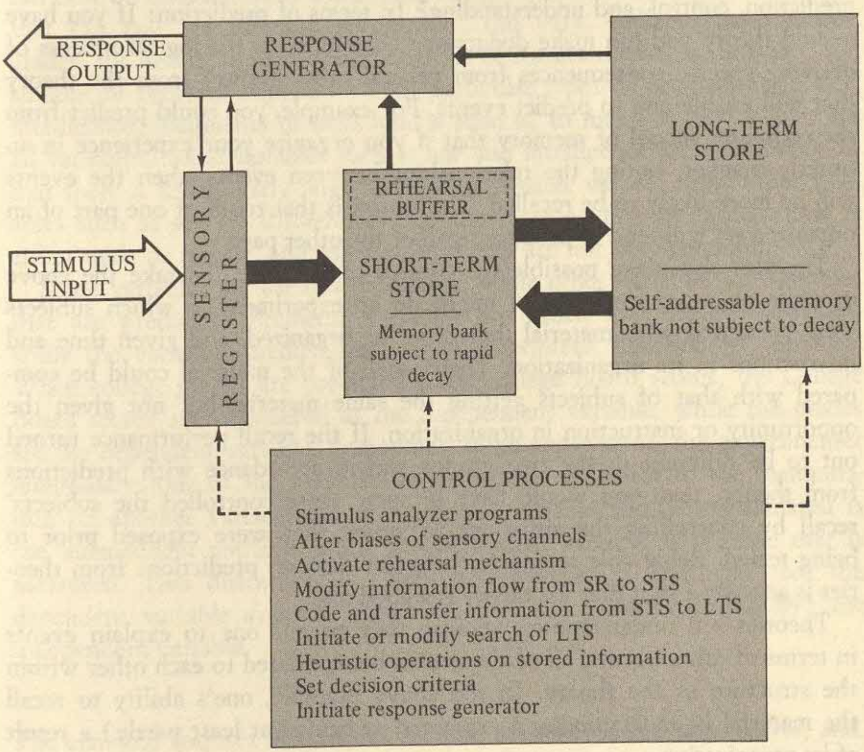
The hypothesized components intervening between input and long-term store include a sensory register, *in which a rapidly fading image of the input is established, and a* short-term store *(STS), in which the persistence of information depends on its being continually rehearsed. Material is held in the sensory register for only a second or so, and will last for only 30 seconds or so in short-term store unless it is rehearsed. The short-term store is also important for responses, because material that is retrieved from* long-term store *(LTS) must go back through short-term store if a response is to be made. The transfer of information from one to another component is under control of a set of "programs" collectively called* control processes, *which include both innate and learned ways of handling information. The model is depicted in the following figure.*

Making such explicit suggestions as to how the memory system functions leads one to ask further questions. For example, it suggests that the way in which material is stored in the long-term store will determine the ease with which it is retrieved later. The extent to which the store is organized, as opposed to being arranged in a random fashion, will determine the efficiency with which material may be retrieved. Suppose that you had to locate some material in a filing cabinet which was not organized according to any plan, but, rather, each new input was simply placed randomly. Locating the material would require you to search through the whole cabinet, which could take a rather long time. If, however, the material were arranged alphabetically, or on the basis of its content, then knowing the general nature of what you were searching for would permit you to look in only one drawer, or perhaps only a part of one.

Studies of memory have suggested that material is "filed" according to several different criteria, including its meaning, the time at which the experience occurred, other events that occurred at the same time, and its physical properties, and any one of these bits of information may be sufficient for you to retrieve it. For example, if you are asked to recall what you were doing last Thursday at 7:00 P.M., you might have the information stored in a location corresponding to "7:00 P.M.," "Thursday," or "last week," or perhaps recalling something about "Thursday" might lead you to remember that Thursday was the night when the club met, which would in turn lead you to remember specific events that happened at the club meeting on a particular Thursday. Experimentation has generally confirmed the notion that memories are established with multiple retrieval tags which indicate the location in the memory store where the information is kept.

Other applications of the model lead one, for instance, to ask in what way the memory is searched. Are locations searched one by one, or several at a time? How long does it take to search one location?

Still other applications lead one to ask the extent to which material stored in long-term memory can affect the operation of particular control processes that, in turn, would affect the way in which material is transferred from the sensory register to short-term store and, perhaps, even whether



From Shiffrin & Atkinson, 1969.

certain information will or will not be so transferred. This statement means that what you have learned previously may affect the way you handle information in the present, and there are various ways to demonstrate this fact. For example, several experiments have shown that "dirty" words are not recognized as easily as more neutral words.

A model, then, can be a very productive aid to the scientist. It does not even make too much difference whether the model is a "true" representation of the phenomenon in question. What is more important is whether it sufficiently stimulates one's thinking about the phenomenon to lead him to make specific observations. Eventually, if enough observations are made, one will gain some better understanding of how accurate the model is and perhaps modify it so as to bring it more in line with the observations.

of psychology is to construct a map of the relationships between factors involved in behavior and experience.

The Function of Theories. How are theories, models, and maps related to prediction, control, and understanding? In terms of prediction: If you have a good theory you can make deductions (deduction is the logical process of deriving specific consequences from general propositions) from the theory that will enable you to predict events. For example, you could predict from the computer model of memory that if you *organize* your experience in an orderly manner, noting the relationships between events, then the events will be more likely to be recalled. The reason is that recall of one part of an organized set will tend to produce recall of the other parts.

Theories also make possible the control of behavior. To take the above example one step further, you might do an experiment in which subjects were presented with material that could be organized, and given time and instructions in its organization. Their recall of the material could be compared with that of subjects getting the same material but not given the opportunity or instruction in organization. If the recall performance turned out to be different in the two groups and in accordance with predictions from theory, then you would have in some sense controlled the subjects' recall by controlling the situations to which they were exposed prior to being tested. Being able to control behavior through predictions from theories is actually a sign that the theory is a good one.

Theories aid understanding because they permit one to explain events in terms of other events, all of the events being related to each other within the structure of the theory. In the above example, one's ability to recall the material is understood and explained as being (at least partly) a result of its organization.

Scientific Methods in Psychology

Given that the goals of psychology are prediction, control, and understanding of behavior and experience, the next question is, how are these goals achieved? In general the answer for psychology is the same as for any other science: by the application of the scientific method to behavior and experience. In the discussion that follows, you will, first of all, learn of some of the general features of the scientific method as applied to psychology. Next you will see how theory and method interact in the development of psychological concepts. Finally, you will see some of the limitations of scientific method in psychology and will be led to question in a constructive way how psychological knowledge can best be obtained.

Variables

Before discussing the major features of scientific method as applied to psychology, however, it is necessary to introduce several new concepts. Up to this point it has been said that psychological science attempts to explicate the relationships between behavioral and experiential events, and to use the understanding thus derived to predict and control behavior and experience. Actually, the relationships studied and the prediction and control can best be understood as statements about *variables.* A variable is a factor that can take on different values, i.e., can vary. College Board scores, grades, the ability to drive a car, number of correct responses on a test, the amount of previous experience with particular types of problems, age, sex, intelligence, judgments of how loud a tone is, to mention only a few, are all variables. Some variables such as age and intelligence are *continuous,* in that there is an infinitely large number of possible values; while other variables such as sex are *discrete,* in that there are no fine gradations. One is either male or female, and in-between scores are not very common.

Some variables are used as predictors, while other variables are the ones that are predicted. Predictor variables are called *independent variables,* while the variables predicted are called *dependent,* or *criterion* variables. When college grades are predicted from College Board scores, the College Board scores are considered as the independent variable, while the grades are the dependent variable. Sometimes, in an *experiment,* the experimenter *manipulates* one of the variables to determine the effect of the manipulation on another variable. In this case the variable that is manipulated is the independent variable, while the dependent variable is the one that is measured. This distinction is easier to remember if you note that the dependent variable *depends upon* (or, in some cases, is caused by) the independent variable.

Observation and Control

The essential features of scientific method are *observation* and *control,* and, indirectly, measurement. It is recognized that factual statements must be based on observation, rather than other grounds, such as revelation or intuition. Knowledge based upon observation is said to be *empirical* (from the

Greek *empeirikos,* meaning *experience*). Thus science in general, and psychology insofar as psychological knowledge is based on observation, is empirical. You should not get the impression, however, that a scientist's intuition and predispositions are not relevant. *Something* must lead him to decide what kinds of observations are going to be relevant and productive. Quite often the decision is made on the basis of intuition and/or the ideas that he has already developed about the topic of interest. Even so, in order for observations to be useful in science, they must be *systematic* and *controlled.*

SYSTEMATIC OBSERVATIONS

The requirement that observations be systematic means essentially that they must be related to theory in some way. An observation in and of itself means nothing unless it relates to other observations or to one's conception of "the way things are." It is sometimes said that observations become facts when they fit into some theoretical framework, i.e., when they are systematically organized and related to other facts and to theoretical ideas.

CONTROL

The requirement of control takes cognizance of the fact that psychological events are determined by many different variables, and that in order to tease out particular relationships between psychological variables, it is necessary to isolate as many of them as possible, and study them one at a time. In other words the scientist exercises control over the situation in which he makes his observations so that, at most, only a few variables are operating to influence the phenomenon in which he is interested, and so that he can, if possible, control the way that even these few variables work (Figure 2.3).

Obviously, some variables are easier to control than others. It is difficult, for example, to control precisely the experiences of a child as he develops in order to learn about the effects of various kinds of early experience on personality development. In other cases the phenomena of interest might be so adversely affected by the procedures necessary for control that the observations would be relatively meaningless.

In general, then, a scientist may be able to exert varying degrees of control over the variables that might affect his observations. Exactly how much control is possible depends on the circumstances. For purposes of discussion we may distinguish three methods for making observations, differing in terms of level of control. These three methods are termed *naturalistic observation, correlational methods,* and *experimental methods.*

Naturalistic Observation. Naturalistic observation is often used when the subjects to be studied cannot conveniently be placed in a laboratory or when the procedures necessary for control would significantly change the phenomenon being observed. For instance, animals reared in captivity are quite different in many ways from animals reared in their natural habitats. Developing knowledge of how animals behave in the wild would not be possible without naturalistic observation. A good example of this method

FIGURE 2.3

This subject is being tested in a soundproof booth. It is not completely soundproof, but it does eliminate many extraneous sounds from outside. Rooms such as this one are often used to control the stimuli reaching the subject in an experiment, so that one can be more certain that variations in his performance are caused by variables that the experimenter manipulates as opposed to random variation in room noise, lighting, etc.
Photo by M. C. Morrow

is seen in the work of Jane van Lawick-Goodall, who lived among a colony of chimpanzees in order to learn about their behavior in the wild (p. 42). This method, although quite useful, is also quite limited because the creatures being observed are, as pointed out above, subjected to many, many influences over which the experimenter has no control. The only thing that can be done by way of learning how to use this method is to learn to make oneself as unobtrusive as possible (in order that the presence of the experimenter not become a factor affecting the observations) and to make as careful and detailed notes as possible. Much of the skill in being a good naturalistic observer is in the ability to group observations, identify meaningful relationships among the events observed, and, in general, to develop abstract conceptualizations of the very concrete observations one makes. This process of going from the particular, or concrete, to the general, or abstract, is known as *induction,* and is very important in the development of any new science.

A problem that must be avoided in naturalistic observation is a prema-

Naturalistic Observation of Wild Chimpanzees

A major contribution to our understanding of primate behavior in natural circumstances was made by Jane van Lawick-Goodall (1968), who in 1960 began to observe wild chimpanzees at the Gombe Stream Chimpanzee Reserve in Tanzania, Africa. During the months in which she was at the reserve, she would spend an average of 12 hours per day watching the animals. At first it was difficult for her to approach very close to them. However, after a year or so they became accustomed to her and would not be disturbed if she approached to within 30 to 50 feet. In 1962 she began to provide food for the animals on an irregular schedule, and they would approach even closer. By 1967 she was able to observe the animals at distances as short as 10 to 15 feet in the vicinity of the feeding area.

Not all behavior was observable at close range, of course, and other devices were necessary. Still cameras, movie cameras, and tape recorders for recording vocalizations were of great use, particularly for documenting the direct observations that she and her colleagues made. The basic pre-

requisite for the success of the study, however, seemed to be the gradual habituation of the chimps to the presence of the human observers. This task, obviously, could not be accomplished overnight.

Of particular interest is her description of tool-using behavior in the chimps. This behavior is quite varied, and in many cases seems to be purposeful and goal-directed. For instance, the animals would throw rocks and sticks at other animals, sometimes in playfulness, sometimes in an apparent attempt to drive them off. They would quite often use sticks and blades of grass as aids in feeding on termites and ants (the insects would bite the sticks and be "fished out" of their nests). (See the accompanying figure.) On other occasions the chimps were seen to use leaves for drinking in much the same way that we would a sponge. Nonpoisonous plants would be selected. They would also use leaves for wiping their bodies.

The fact that this behavior occurred in the wild, and, for the most part, without props provided by human beings, is indicative of a level of behavioral organization that would be difficult to duplicate in a laboratory setting or, for that matter, in any form of captivity. Although there have been numerous studies of learning and problem solving in chimpanzees in the laboratory, and these studies have contributed a great deal toward our understanding of primate behavior, finding such behavior as Goodall has reported in a naturalistic setting adds a dimension to our understanding that could not have been gotten otherwise.

ture attribution of behavior to particular causes. One especially bothersome instance of this problem is that of *anthropomorphizing,* or attributing the behavior of animals to human or humanlike motives. Although anthropomorphizing is not limited to the naturalistic observation method, it is more likely to be a problem here, since it does provide for a certain economy of description of behavior and seems to be a natural tendency of many human observers. The point is that behavior should be described in relatively neutral terms that do not carry with them meaning over and above their descriptive function.

Correlational Methods. The use of correlational methods is quite common in psychology. The essential feature of the correlational approach to knowledge is that one is able to discover variables that "go together," or that, in other words, are correlated. One may find, for example, that people who obtain high scores on a scale measuring authoritarian tendencies also tend to hold more negative attitudes toward people different from themselves. Or, one might find that females develop verbal skills before males do. In both cases a person's standing on one variable (authoritarianism in the first example, sex in the second) is used to predict his standing on another variable (attitudes toward people in the first, and verbal development in the second). If, indeed, such predictions can be made, then one might assume

that the two variables (the independent and the dependent variables) have something in common. The finding of a relationship between the two variables does not in itself indicate what might be common between them, nor does it indicate that one of the variables *causes* behavior on the other one. Thus the fact that girls develop verbal skills before boys does not in itself explain why, nor does it indicate that being female causes one to become verbally competent earlier. It simply means that some one or more of the many factors associated with being female is also involved in some one or more of the many variables associated with verbal skills. Further research would attempt to determine what those variables are.

In general, then, the correlational methods may provide quite useful information as to what kinds of things go together, and this information might lead to some important hypotheses to explain the correlations. If, however, one attempts to infer cause-and-effect relations from correlations, he runs the risk of being wrong unless the logic of the situation also strongly implies cause and effect. As pointed out by the tobacco industry, the fact that there is a relationship between smoking and lung cancer does not, in and of itself, mean that smoking causes lung cancer. It may well be that both smoking and lung cancer are caused by some common factor which, on the one hand, causes people to smoke and, on the other, causes them to get lung cancer. The logic of the antismoking argument, however, is that, since the correlation has been found under a variety of circumstances, the suggestion of a cause-and-effect relationship is strong enough to make an intelligent decision. Regardless of the issue, the only way to demonstrate conclusively a cause-and-effect relationship is to use the experimental method.

Experimental Method. The experimental method employs the greatest degree of control over the variables affecting the phenomenon of interest. The essential characteristic of this method is that the scientist systematically *manipulates* variables that he thinks affect the phenomenon he is interested in and observes the results of the manipulation. If the behavior changes when the manipulation changes, then presumably the manipulation caused the change. For example, if one is interested in the effect of televised violence on aggressive behavior in children, then application of the experimental method would require that the scientist manipulate exposure to TV violence. From a group of children who had never been exposed to televised violence, he would have to select some children who would continue not to be exposed to violence and others who would be so exposed in a controlled manner. After an appropriate period of exposure, some measure of their aggressiveness would be taken. If exposure to the TV violence had indeed been controlled, and if they showed differences in later aggressiveness, then one would be more likely to say that TV violence caused the aggressiveness in the children.

This experiment would, in practice, be quite difficult to make because of the difficulty of controlling the exposure of the children to television. However, it illustrates the point that in an experiment the scientist actively

manipulates a factor in groups of subjects who, on any other basis, *would not be expected to be different from one another* (i.e., whose other characteristics are *controlled*). In the smoking example above, one would have to take two equivalent groups, neither of which had ever smoked before, and require one of the groups to begin smoking and the other to refrain from smoking. The subjects would have to have no part in the decision as to which group they would belong to, since, according to the rationale above, there might be a common factor related both to the decision to smoke and the development of lung cancer. Obviously, this experiment would be just as difficult to do as the one on television and violence because one would have to exercise what most people would regard as undue control over the lives of other people.

The example of the laboratory study of memory on p. 34 in which the distinctiveness of the material to be memorized was manipulated is also appropriate here. By directly manipulating this factor, and observing the effects of the manipulation, the experimenter was able to make a statement about distinctiveness as one *cause* of variations in memory.

In practice, all three methods are used in psychology. The experimental method is used wherever it is possible and in situations in which the necessary controls would not unduly interfere with the behavior observed. There are many circumstances, however, in which one must decide about cause-and-effect relationships on other than the most adequate grounds. In such cases one must decide if a cause-and-effect statement is *reasonable* given, say, correlational evidence, without knowing for sure. You could, in fact, regard the three methods above as simply aids to the scientist. They aid him in making decisions about whatever he is interested in. Experimentation usually makes the decision easier but not always, and it cannot always be done, in which case he must make his decision on other grounds.

MEASUREMENT

It is generally agreed that progress in any scientific field is dependent to a great extent on the ability to quantify the phenomena under investigation. The beginnings of experimental psychology are seen in Fechner's development and Wundt's application of techniques for measuring sensations, and Ebbinghaus's application of these methods for the measurement of the strength of associations. In the field of individual differences the study of intelligence was given a major boost when Binet and Simon devised a method for measuring intellectual ability. In a similar manner progress in the study of personality was associated with the development of personality tests.

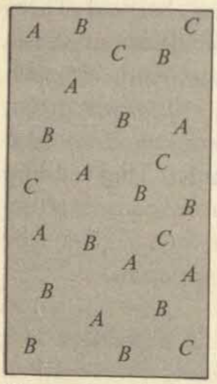
What is measurement, and why is it so important? Measurement may be defined as the application of numbers to phenomena on the basis of a set of rules. Depending upon the nature of the phenomena measured, measurement may consist of *classification and counting, ordering,* or *applying a single unit of measurement.* (See Figure 2.4.)

Classification and Counting. Classification requires that one be able to identify phenomena and group them on the basis of their similarities and

differences. Without at least this ability to classify observations and events, it is not possible to have a science at all. Linnaeus's development of a system of classification (or a taxonomy) of plants and animals was essential for the later development of the biological sciences. In the physical sciences classification of the elements, and later their constituents, was essential for subsequent developments. In psychology the classification of various components of behavior and experience such as sensations, images, and reflexes, was important, as was the identification of various types of goal-directed behaviors such as appetitive or approach behavior, avoidance behavior, aggressive behavior, etc.

Once the relevant events can be identified and classified, then one can at least count them. Counting permits one to do research, in that factors related to the frequencies of occurrence of the various events of interest can be studied.

Ordering. It is also possible to classify events on the basis of whether one event is greater or lesser than some other event with respect to some variable. For instance, one might order his family and acquaintances on the



There are

_____A's

_____B's

_____C's

(a)

String beans ____
Asparagus ____
Corn ____
Turnips ____
Beets ____
Peas ____
Cabbage ____
Carrots ____
Spinach ____

Put a number in the blank that corresponds to your preference for the vegetable

1 = most preferred
9 = least preferred

(b)

Trial	Reaction time (milliseconds)
1	423
2	350
3	372
4	325
5	354
6	322
7	343
8	320
9	331
10	319

The fastest reaction time is ____ milliseconds faster than the slowest? The slowest time is ____ times longer than the fastest?

(c)

FIGURE 2.4 *Types of measurement: (a) Classification and counting; (b) ordering; and (c) an interval and ratio scale. In (b), numbers are assigned according to rank order with respect to some dimension (in the example, preference as a food), but the numbers carry no additional meaning. If corn gets a "1" and turnips a "9", that does* not *mean that corn is 8 units more preferred than turnips, or that it is nine times as preferred. In the interval scales (c) the unit of measurement is the same throughout the scale. In the example, 5 milliseconds difference in reaction time means the same regardless of the particular values being compared. The scale used is also a ratio scale, in that there is a meaningful zero point (i.e., an instantaneous reaction). Therefore, different reaction times can be compared as to how many times longer one is than the other.*

basis of their importance to him. The events are the people involved, and the variable on which they are ordered is personal importance. In some forms of behavior therapy patients are asked to order various goals on the basis of their attractiveness or aversiveness. Artistic paintings may be ordered on the basis of their appeal. The possibilities are quite numerous. All that is required is that one be able to say that a given event has more or less of some quality than another event. The resulting scale is called an *ordinal scale*.

Applying a Unit of Measurement. While ordering may give you information about whether one event is greater or less than another, it does not permit you to say *how much* greater or less. The use of a constant unit of measurement, however, does permit you to say how much (i.e., how many units). When a constant unit is used, the resulting scale of measurement is called an *interval scale*, or sometimes an *equal-interval scale*. In the Fahrenheit temperature scale the unit of measurement is the degree, and the number of degrees difference between, say, a glass of cold and a glass of hot water, can be determined. One important feature of the interval scale is that, since there is a single unit used to measure the separation between events, a given number of units of separation at one point on the scale means the same thing as the same number of units at another point. For instance, the difference between 22° and 35° is 13°. The difference between 49° and 62° is also 13°, and the two differences are equal.

Whether or not there are any interval scales in psychology is a matter that has been debated. It has been suggested that some scales of perceived magnitude, such as brightness, weight, length, loudness, etc., are interval scales, and it has also been suggested that scales like the I.Q. (intelligence quotient) scale also have interval properties.

Some interval scales have true zero points, which reflect the absence of the quantity being measured, and others do not. If a scale has a true zero point, it is called a *ratio scale*. The Fahrenheit scale is *not* a ratio scale of temperature because 0° does not indicate the absence of heat. The Kelvin scale, however, is. Its zero (−273°C) presumably reflects the absence of heat. The intelligence scale is *not* a ratio scale because the concept of zero intelligence is a rather difficult one to grasp and is certainly not indicated by a low score on an intelligence test. Some scales of perceived magnitude are, however, ratio scales, in that the number zero may indicate the absence of a particular sensation (i.e., in a completely dark room, one may perceve zero brightness).

The only advantage of a ratio scale is that one can say that a given event is, for example, twice as great as another event, or one-third as great. In other words, events can be compared using multiplication and division.

Why is measurement so important in science? First of all, measurement provides the basis whereby one can systematize his observations and communicate them to others. Without at least classification and counting, systematic study would not be possible and it would not be possible to communicate with other people about one's observations. Second, measurement

provides the basis for the application of many powerful mathematical tools to observations. One can simply do much more with his observations if they are made in such a way that mathematical techniques may be applied to them.

RELATIONSHIP BETWEEN THEORY AND OBSERVATION

The Nature of Constructs. As pointed out above, a theory is an abstract statement of a relationship between variables. A theory can predict and explain events in the world to the extent that these events are related to the variables in the theory. However, the problem is to relate the terms of the theory, which may be quite abstract, to the concrete events in the world that one wishes to predict or explain. The more abstract the terms of the theory, the less obvious is the relationship between the theory and the real world. Let us take a specific example: *Anxiety* is a variable that has central importance in some areas of psychology. It can motivate one to learn behaviors that will reduce or eliminate it, and it may disrupt performance when it is especially strong. In small doses it may actually facilitate performance. It may be experienced as a chronic state, always present from day to day, or it may be experienced only as a response to specific stressful situations. It is mostly unpleasant, although some people seem to like small amounts of it. As a theoretical concept, then, it is important in learning, motivation, and personality.

Just what is anxiety? It is not a thing, like a table or a chair that can be observed directly, although, as indicated above, people may be said to have it in greater or lesser amounts. Rather, it is a *concept,* or more appropriately, a *construct.* The term *construct* emphasizes that it is built up from observations, or invented in order to organize certain observations and relate them coherently. In other words, anxiety is not directly observable, but its meaning is related to certain events that can be observed. The concept is related to observable events by means of *operational definitions.*

Operational Definition. An operational definition simply indicates the operations that you must perform in order to observe evidence of the variable, or construct. In the case of anxiety, several definitions are possible. First of all, you might specify the *antecedent conditions* (i.e., the previous circumstances) necessary to produce it, such as having some traumatic experience (Chapter 14). Or you might define it in terms of some *response* on the part of the subject. A number of responses have been taken as indices of anxiety, including verbal report ("Do you feel anxious?" "Yes."), or reporting certain problems with bodily function, such as frequent nausea, sweating, diarrhea, etc. There are also physiological indices of anxiety, including the *galvanic skin response* (GSR, an electrical response of the skin), changes in heart rate and respiration, and increased diameter of the pupil of the eye.

Anxiety, then, is a construct whose meaning is given in terms of the operations one must perform to "observe" it. (See Figure 2.5.) It is also a component of some theories in psychology, e.g., various theories of personality, and some theories of motivation and learning. The theories, of

course, contain other constructs as well, each of which is in some way related to observations.

Not all psychological constructs are easy to define operationally, and not all psychologists think about them in operational terms. Quite often the use of terms is more intuitively based than the preceding discussion would suggest. The concept anxiety, for example, not only has the operational meaning sometimes given to it by investigators, but also other meaning which may be more personal and idiosyncratic for the scientist. In his thinking about anxiety, this meaning as well as the more systematic operational meaning may be influential.

It is easy to forget that certain constructs are *just that,* and not real things. Intelligence, anxiety, habit, perception, hunger and thirst, to mention only a few, are all *constructs,* not things. When we forget and begin to regard abstract concepts as things, we *reify* them (from the Latin *res,* meaning *thing*). Reification is a problem because in so doing we often lose sight of the relationship between the reified concept and observation, and without observation it is difficult to have scientific knowledge.

Science as a Human Enterprise

Scientists are people. They are people trying to make sense out of a particular chunk of reality that interests them. To "make sense" out of something means to many scientists to relate it to a particular theoretical account of the way things are. Where does one start? How does one proceed in the process of developing understanding? How does one decide what to observe, and how does one decide among alternative theoretical accounts of them?

In psychology, as in other fields, the scientist begins with some basic orientation to the world. This orientation is the result of his past history,

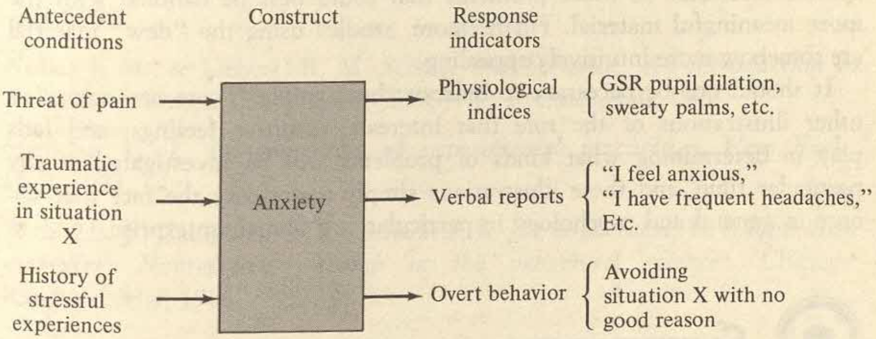


FIGURE 2.5

The construct anxiety is given operational meaning by being related to antecedent conditions that supposedly give rise to it, and to responses that presumably indicate its presence. The responses do not always agree with one another about the presence of anxiety; for example, verbal reports may deny its presence while physiological measures or overt behavior may indicate its presence, or, for that matter, any other combination of indices is possible. Consequently, anxiety, like many other psychological constructs, is difficult to "pin down" in a precise manner.

which is not necessarily the product of scientific activity. As a result, it often happens that different theoretical positions are taken largely on the basis of intuitive appeal. For example, in the field of personality, one will adopt a Freudian, social learning, or humanistic approach, not on the basis of how well the different approaches account for people's behavior, but because one prefers to regard man's behavior as largely determined by unconscious processes (Freudian), learning in social situations that takes place in relation to reward and punishment (social learning), or behavior that is determined by what one is aware of at the moment (humanistic).

Fad also plays a role in determining the orientation that one will take and the kinds of investigations one will make. In the field of human learning, it is quite popular at the moment to use digital computers as models for the human learner, and there is talk of storage and retrieval processes, buffers, memory search, etc. In past years it was more fashionable to talk of traces and associations between stimuli and responses. Actually, the decision to use one or the other approaches to learning is not based on the adequacy of the approaches in any real sense. No one has shown that associations do not work in explaining human learning. It is just that, for some people, it is more interesting to talk about computers than about associations, and some analogies may be more productive of experimentation than others.

Methods for studying problems in psychology are also subject to fad. In the field of human learning the nonsense syllable (two consonants with a vowel in the middle) was used quite extensively because it has relatively less meaning than, say words or sentences, and it was thought that it was necessary to hold constant (i.e., to control) this factor. Now there is a shifting emphasis to the learning of words and even of sentences. The reasons for the shift are not to be found in the inadequacy of nonsense syllables for investigations of the learning process but because investigators became interested in other problems that could best be handled with the more meaningful material. Furthermore, studies using the "new" material are somehow more intuitively appealing.

It should not be necessary to belabor these points. There are numerous other illustrations of the role that interests, intuitive feelings, and fads play in determining what kinds of problems will be investigated at any particular time, and these illustrations simply underscore the fact that science in general and psychology in particular is a human enterprise.

Summary

The goals of psychology are prediction, control, and understanding of behavior and experience. Prediction may be clinical, pertaining to the individual case, or actuarial, relating to group tendencies. The control of behavior is seen in various applications ranging from psychotherapy to the

design of equipment to maximize human learning and performance. Understanding comes from the ability to relate observations to each other and to theories about behavior and experience, and promotes the ability to predict and control. A theory may be compared to a model of some phenomenon or to a map of some territory. In both cases events of interest are related to each other in such a way that the relationship can be grasped easily.

The goals of psychology are met by the application of scientific method to behavior and experience. This method involves systematic controlled observation and measurement, and may be accomplished by means of naturalistic observation, correlational methods, or experimentation. These methods differ in the degree to which the scientist is able to exercise control over the events of interest, with the greatest control being possible in the case of experimentation. Measurement is essential because, without it, systematic observation is impossible. Different types of measurement include classifying and counting, ordering, and applying equal units of measurement.

Observations are related to theories through the use of operational definitions. The abstract terms or constructs of a theory may be defined in terms of a number of different operations, each of which involves observation in some way.

Science, including psychological science, is a human enterprise. As such it is partly determined by the attitudes, interests and other predisposing factors of the investigators. Fads are quite common and determine in a significant way the kinds of problems that will be investigated.

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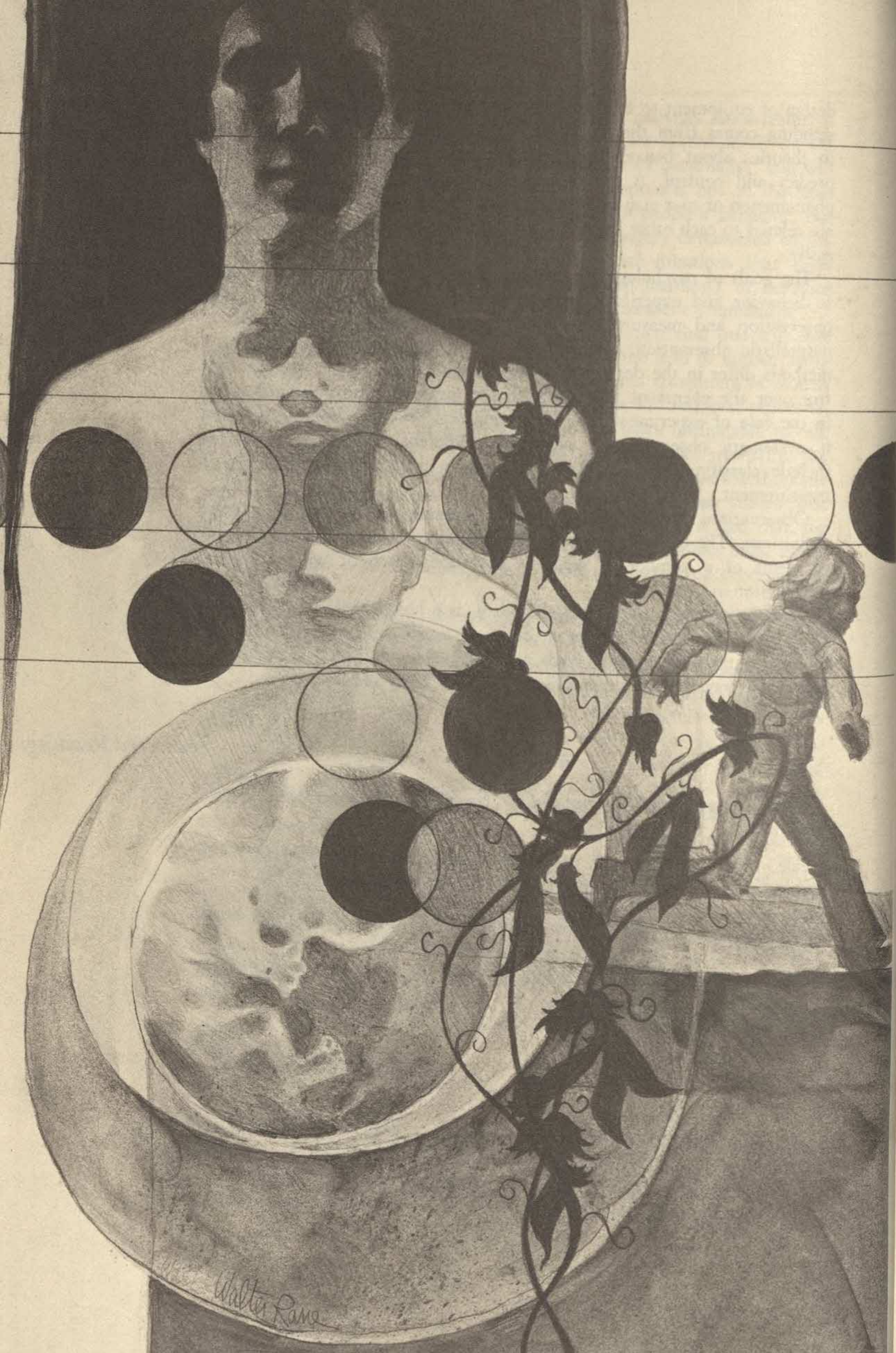
Walter Rane

Heredity, Growth, and Development

3

Animals, including human beings, are biological creatures, and the complexities of their behavior and experience may at some point come to be understood as expressions of biological processes. These processes operate within limits provided by the structure of the particular organism—bones, muscles, nerves, glands, etc. The structure and the mode of operation of the biological process are largely determined by the genetic makeup of the individual, i.e., by inheritance. The characteristics of the inherited structures and processes, however, are the product of evolutionary changes taking place over many, many generations. Thus the individual at birth is not only the product of the genetic endowment provided by his two parents, but also the product of a long evolutionary history. Moreover, one's biological endowment is not fully realized at birth but may be said to unfold through the course of his life.

The goal of this chapter is to acquaint you with (1) evolutionary and genetic processes whereby the individual becomes what he is at birth, (2) some of the implications of genetic determination for psychological characteristics, and (3) some of the principles of growth and development after birth.

Heredity and Behavior

Evolution

It is sometimes said that Charles Darwin's book, *The Origin of Species* (1859), is the greatest scientific achievement of modern civilization (Boring, 1950). It was certainly the most controversial work of its day and has probably had at least as great an impact on conceptions of human nature as any other work, including that of Freud. Darwin's achievement was to develop and present the first extremely systematic and broadly documented account of the evolutionary development of the various species.

Darwin argued that the different species of animals were not created independently in accordance with the story in the Book of Genesis but were the product of a long history of development from common ancestors. His theory as to how that development occurred is known as *natural selection*. Noting that individuals within a given species differed from one another in many ways, he suggested that these differences were important factors determining how well a particular individual would adapt to his environment. Individuals whose characteristics fit in and permitted them to flourish would reproduce their own kind and thus propagate those adaptive characteristics. Individuals less ably endowed would tend not to reproduce as much, and thus their characteristics would not be seen as much in later generations.

The variations within species that were so important for the working of natural selection were thought by Darwin to arise spontaneously. This notion is in contrast to that of an earlier biologist, Lamarck, who thought that species could be improved through adaptive effort. In other words, Lamarck thought that acquired characteristics could be passed on to offspring. Darwin rejected this idea, suggesting that the variation in characteristics arose through means other than adaptive learning. Of greatest importance was the natural variation in characteristics occurring at birth, now known to be due to the natural variation in the arrangement of chromosomes that happens at fertilization. Mutation may also occur in which an individual's genetic makeup can be changed by physical means such as X-radiation or chemicals, possibly including caffeine and LSD. Mutations produce rather abrupt changes in characteristics which, when they occur, are often maladaptive.

Evolution is important in behavior because of the role that behavioral processes play in adaptation to the environment. Just consider the importance of acute vision and hearing for a small animal that is the natural prey of some larger animal. Certain moths, which are the natural prey of bats, have an instinctive response of avoiding the high-pitched sounds produced by the bats in locating their prey (Roeder & Treat, 1961). Clearly, such a behavioral process promotes survival of that species of moth. Other examples will be given in Chapter 12, which deals more explicitly with instinctive behavior.

Evolution does not always seem to work intelligently. Lorenz (1966) gives an example of the male lyrebird. This bird has elaborate tail plumage

that is very attractive to female lyrebirds. Those males with the more elaborate plumage are more successful in mating, and their male progeny inherit their elaborate plumage. Natural selection, then, exerts pressure in favor of elaborate tail feathers. However, at this point in evolutionary history the male bird is so burdened down with tail feathers that he can do very little else but display them and mate. Thus overspecialization may not in the long run be adaptive. Lorenz raises some interesting issues in regard to human characteristics, including aggressiveness, and suggests that similar processes may have operated to produce some of the problems with aggression that we have today.

The important point to remember in connection with evolution and behavior is that present-day animals, including people, are the way they are partly because of natural selective processes operating over many hundreds of generations.

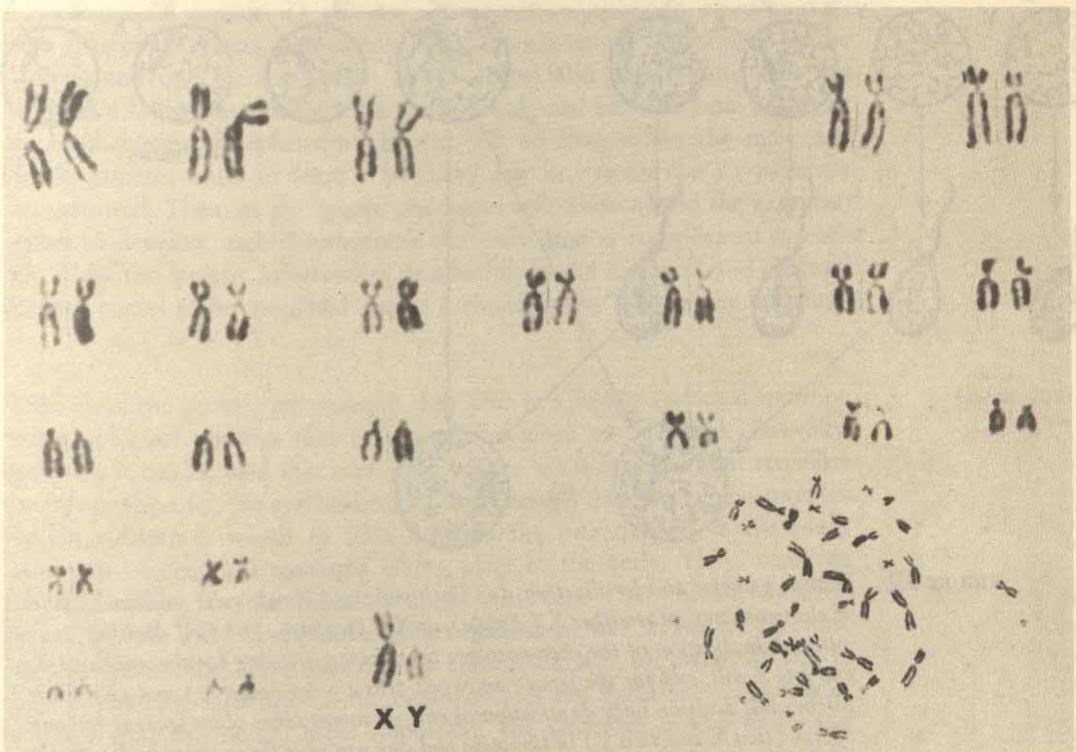

FIGURE 3.1

Human chromosomes. All 46 are shown, including the X and the Y chromosomes, which are indicated. The chromosomes are from a male. The chromosomes in the inset were arranged according to size for the main illustration. Courtesy of Dr. Arthur Falek, Georgia Mental Health Institute.

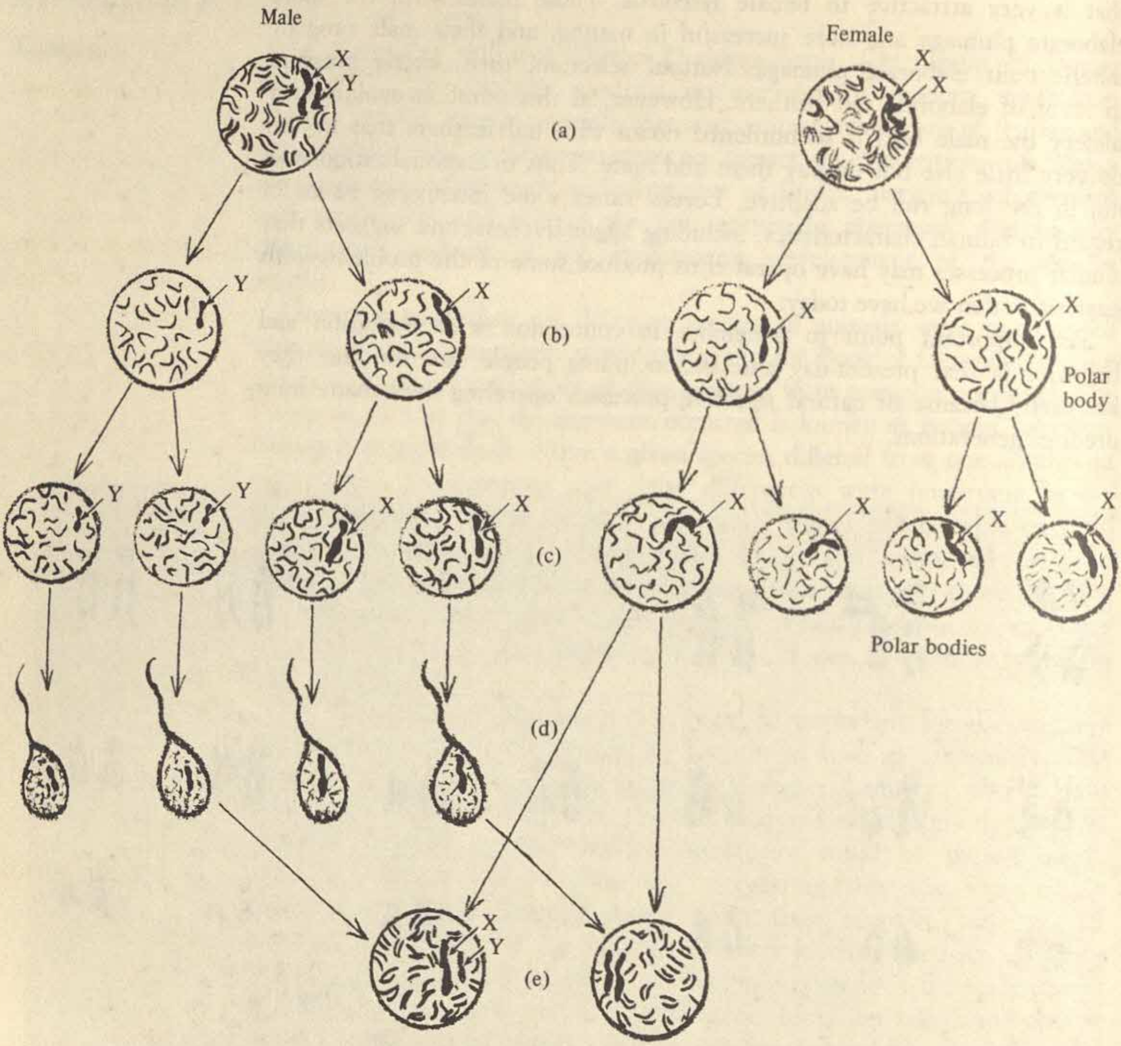

FIGURE 3.2 *Human gametes and fertilization. (a) Both male and female cells contain 22 pairs of chromosomes, plus either XY (male) or XX (female). (b) Cell division without duplication of the chromosomes takes place, yielding for the male one X and one Y cell, and for the female an X cell plus a polar body. (c) and (d). One further cell division with duplication of chromosomes takes place leading to four sperm (two X and two Y) in the male and one egg plus three polar bodies in the female. The polar bodies contain little cytoplasm and disintegrate later. (e) Egg and sperm unite to form a zygote. The one on the left, containing X and Y chromosomes, will develop into a male, while that on the right, with two X chromosomes, will become a female.*

Genetic Transmission

While the details of genetics are best left to a course in biology, certain basic ideas are necessary for the development of a background against which to understand behavioral inheritance, to be discussed later in this chapter.

CHROMOSOMES AND GENES

The information that is passed from parents to children and provides the basis for inheritance is contained in the *chromosomes,* which are located within the nucleus of the cell. (See Figures 3.1 and 3.2) Each chromosome is composed of many *genes*, which are tiny packages of a chemical known as deoxyribonucleic acid (DNA, for short). Different chromosomes contain different numbers of genes, but the total number of genes in a given cell is probably 200,000, with half coming from each parent (Robinson, 1970).

Human cells contain 23 pairs of chromosomes, although other animals have different numbers. One chromosome in each pair is contributed by the mother, and one by the father. When sperm and eggs (these cells are technically known as *gametes*) are formed, only one member from each pair of chromosomes is represented in the cell, so that, when the male and female gametes unite to form a fertilized egg, or *zygote,* the 23 pairs are reconstituted. Then, as the zygote undergoes cell division, and the organism begins to develop, each chromosome and each gene is reduplicated in each cell. Thus the genetic information originating in the maternal and paternal gametes comes to be contained within each cell in the body of the offspring.

GENE ACTION

What does the genetic information do? This is a highly technical question in physiological genetics that is beyond the scope of this book. Basically, however, it can be said that each gene carries within its chemical structure the information for the synthesizing of one *enzyme.* An enzyme is a complex protein substance, which in turn controls the rate of one of the many thousands of chemical reactions taking place in the body. These reactions are responsible for the building up of structure (i.e., bones, muscles, nerves, glands, etc.) in the developing organism as well as for its functioning throughout life. The relevance of these processes for behavior lies in the fact that the structure of the organism sets the limits for the kinds of behavior that can occur. Most important, the structure of the brain and other parts of the nervous system partly determines such psychologically relevant processes as motivation, learning, perception, thinking, etc. An example of how one gene can affect behavior is given on p. 58.

As indicated above, chromosomes come in pairs, one from the mother and one from the father, and each gene within one chromosome is paired with a corresponding gene in the other chromosome. A number of adult characteristics are determined by the action of only one or two genes, e.g., eye color and color blindness. These characteristics are easy to study because rather precise predictions about the offspring can be made from

Phenylketonuria

Phenylketonuria is a metabolic disorder that is caused by one recessive gene, and which has profound psychological consequences. The psychological implications stem from the fact that individuals who have the disorder are likely to be mentally retarded.

The disorder was discovered about 40 years ago in a research program aimed at discovering possible chemical bases for mental disturbance. It was found that the urine of some of the retardates tested stained green when ferric chloride was added to it. The green color was found to be caused by an excessive amount of phenylpyruvic acid.

Phenylpyruvic acid is one of the products of the metabolism of phenylalanine, one of the amino acids. The person with phenylketonuria is missing an enzyme that controls a chemical reaction involving phenylalanine, with the result that most of it is converted to phenylpyruvic acid, which then accumulates in the bloodstream to a level about 30 times normal. An excessive amount of phenylpyruvic acid damages the nervous system, thus causing the mental deficiency.

The disease, which occurs in about 1/40,000 of the population, can be controlled by administering a diet deficient in phenylalanine. It is easily diagnosed in early infancy and, if treated soon enough, the severe psychological disturbances do not occur.

Phenylalanine has been administered in high quantities to monkeys, and it has been shown to produce defects in discrimination and in learning.

Note how the psychological effects of the disorder are indirectly determined by the individual's heredity. It is not that the genetic disorder always causes mental deficiency. It is only caused when a certain substance is taken into the diet in what, for other individuals, would be normal quantities. A single chemical reaction which, on the face of it, would seem to be incapable of producing so profound an effect on so complex an organism as a human being, is shown to be, in the normal course of events, essential for normal mental development.

One wonders how many other disorders of a psychological nature will eventually turn out to be of a similar nature. Unfortunately, most other disorders have not yielded so readily to analysis, even though there is evidence of genetic factors (e.g., schizophrenia and manic-depressive psychosis). Part of the difficulty lies in the fact that many genes seem to be operating, rather than only one, as in the case of phenylketonuria, and their heredity cannot be traced so easily. (McIlwaine, 1966.)

knowledge of the parents' characteristics. Other characteristics seem to depend on several or many genes, and it is much more difficult to study the genetic transmission of them.

Dominant and Recessive Genes. When a single gene pair determines a characteristic, one member of the pair may completely determine the characteristic. The determining gene is said to be *dominant,* while the other one is *recessive.* A recessive gene will only determine a characteristic if it is paired with another recessive gene. If it is paired with a dominant gene, then the characteristics associated with the dominant gene will be the ones seen. In Table 3.1 are shown some dominant and some recessive characteristics.

Sex Linking. The sex of the baby is determined by one particular pair of chromosomes (Figures 3.1 and 3.2). One member of the pair is called the X chromosome, the other member the Y chromosome. The female gamete carries two X chromosomes, while the male gamete carries both an X and a Y chromosome. If the X chromosome from the male is paired with an X from the female, then the child will be female (XX). A Y chromosome from the male, paired with the female's X chromosome, produces a male.

In addition to sex, some other characteristics are determined by the X and Y chromosomes. Such characteristics are said to be *sex-linked.* An example is color blindness, which is caused by a recessive gene on the X-chromosome. The Y-chromosome carries no gene for color vision, so, in a male, normal color vision or color blindness will be determined by the gene on the X-chromosome contributed by the mother. Since a female has two X chromosomes, it is quite likely that at least one of them will contain a dominant gene for normal color vision, and thus the female child will have normal color vision. The only way for a female to be color-blind, then, would be for both of her parents to be color-blind. A male, however, can be color-blind if (1) his mother is color-blind (i.e., both X chromosomes

TABLE 3.1

Dominant and recessive characteristics

Dominant	*Recessive*
Normal hearing	*Congenital deafness*
Normal amount of hair	*Baldness*
Dark hair	*Light hair*
Curly hair	*Straight hair*
Normal color vision	*Color blindness*
Dark eyes	*Light eyes*
Poison ivy immunity	*Poison ivy susceptibility*
Normal amount of skin pigment	*Albinism (lack of pigment)*
Double jointedness	*Normal joints*

Source: Adapted from Krech, Crutchfield & Livson, 1969, p. 29.

Sex Chromosomal Abnormalities and Behavior

In the last 10 years or so there has been an interest in the possibility that abnormalities in the chromosomes that determine the sex of the individual may be associated with the tendency to commit antisocial acts. Several different abnormalities have been discovered, the best-known one being the so-called XYY type. Ordinarily, a male has one X and one Y chromosome, the Y chromosome being responsible for male physiological characteristics. A normal female has two X chromosomes. The XYY type has an extra Y chromosome, and this type occurs in from 1 to 4 male individuals per 1000 in the population at large (Hook, 1973). Such males are usually somewhat taller than average and, according to some reports, are predisposed to acne.

One of the first reports of possible behavioral consequences of the XYY syndrome came from Sweden, where there was greater than expected incidence of XYY males among those mental patients who were hard to manage. Since the original reports a large number of investigations have been made in which inmates of mental hospitals, penal institutions, and combined mental-penal institutions, as well as normal individuals, have been examined for this abnormality. Not all of the studies have yielded positive results. That is, sometimes there is a greater than normal incidence of the XYY type in these institutions, and sometimes there is not. However, when all of the studies are considered together, and evaluated on a number of grounds relating to the possibilities of biases in the samples selected, it seems clear that there is a somewhat higher incidence of XYYs among institutionalized males, particularly among those in combined mental-penal institutions, where the incidence of XYY is about 2 percent (Hook, 1973).

If there is, in fact, such an association between chromosome type and antisocial abnormality, what is its basis? Several hypotheses have been advanced. According to one of them, it is possible that XYY individuals are more likely to be born into circumstances which on sociological grounds are more likely to lead to deviant behavior. Another view is that, because of their increased height, such individuals would be reacted to by their peers in such a way that deviant behavior would be the outcome. Another hypothesis is that the abnormality causes some change in the brain and/or endocrine system which, in turn, would result in abnormal behavior.

Several studies have been performed in which the electrical activity of the brains of normal persons were compared with XYYs, and other studies have compared the functioning of endocrine glands known to influence behavior (e.g., the sex glands) in the two groups. Thus far, there are no conclusive findings one way or the other. There is little direct evidence bearing upon any of the other hypotheses either, so, at present all that can be said is that the matter needs further study.

There are other chromosomal abnormalities as well. About 1 in 900 males have an extra X chromosome (i.e., XXY) and tend to be sterile and to have underdeveloped testes. There is also a slightly increased risk of slight mental retardation in these males, as well as a somewhat greater chance of being institutionalized in a mental-penal institution, but the increased risk is not impressive.

A third syndrome, XXYY, occurs in about 1 in 25,000 males. The incidence of this abnormality is about 50 times higher in mental-penal institutions than it is in the population at large, although the absolute numbers of cases are so small that it is difficult to say much more about the syndrome.

These findings have been misapplied in a number of cases, and their implications, particularly when they are offered as evidence in criminal cases involving XYY individuals, are quite far-reaching. While the association between the syndrome and deviant behavior may be valid, the findings do not *indicate that an individual, just because he is an XYY type, is bound to be deviant, or, for that matter, that his behavior is in any way explainable by the abnormality. Thus caution seems to be called for, since there is absolutely no indication that every XYY type is deviant, and indeed, there is at present no evidence that noninstitutionalized XYYs are excessively deviant.*

carry the color-blindness gene), (2) if she carries a recessive gene for color blindness and he gets *that* X chromosome rather than the one with the gene for normal color vision, or (3) if both parents are color-blind. As you might expect, color blindness is much more prevalent among males than among females.

Some individuals may have an extra X or Y chromosome, in which case they are said to be XXY or XYY. In recent years there has been a good bit of interest in the behavioral consequences of this condition (see p. 60).

LIMITS OF GENETIC VARIABILITY; HEREDITY AND ENVIRONMENT

Exactly how much variation can be expected from genetic differences? The answer is very, very much, but you may have a little better idea of how much if you consider how many different ways 23 pairs of chromosomes may be grouped. There are 2^{23} possible groupings, which is more than 9.4 billion. And that is from only one set of parents! Multiply that figure by the number of sets of parents in the world, and it is no wonder that people are so different from one another. In fact, it is quite unlikely that any two persons would be the same.

The only exception is in the case of identical twins. These individuals develop from the same zygote. After fertilization the zygote may split into two parts, each of which develops into an individual each with the same genetic make-up as the other.

You may wonder how flexible or inflexible are one's characteristics resulting from a particular combination of maternal and paternal genes.

Actually, the answer to that question must await research in physiological genetics, in which the mechanisms of gene action are being studied. Some very general statements may be made, however.

First of all, genes differ in terms of their *penetrance,* or the extent to which their presence is manifest. A gene with 100 percent penetrance will always produce a particular end result, while one with 50 percent penetrance will have its effect in only half of the individuals possessing it. A gene of less than 100 percent penetrance may depend for its expression on environmental circumstances or on internal factors such as hormone levels in the blood. For example, the gene responsible for baldness in the male will express itself only in the presence of high levels of androgens (male sex hormones) in the bloodstream. Thus most females who have the gene do not become bald unless they have unusually high levels of male hormones.

In general, it can be said that at no point in time following conception is a developing organism independent of its environment. The embryo is dependent upon the maternal blood supply for a constant supply of nutrients, which of course make up the structural parts of the infant. The enzymes whose chemical structure is controlled by the genes must be synthesized from chemicals coming from outside the cell; the reactions that the enzymes control are reactions of constituents coming from outside the cell, and normal development depends upon a sufficient supply of whatever is needed. Thus abnormalities in the chemical environment may result in abnormalities in the structure or functioning of the infant. For example, several drugs are known to produce birth defects. Thalidomide, a drug given mothers to alleviate nausea, can cause abnormal development of the limbs if taken during the period when the limb buds are developing on the fetus. Also, deficiencies in various dietary substances, particularly proteins, in the maternal diet may result in insufficient development of tissue, including brain tissue (see Chapter 15).

In spite of these environmental effects, however, it should be made clear that the genes determine the limits within which these factors can work. The specific range of effects of thalidomide, for example, on development, is set by the genes responsible for the structure of the tissues that are affected.

To return to the question at the beginning of this section: What proportion of the total amount of variation among individuals can be accounted for in terms of heredity? The answer is that in a constant, adequate environment, most of the variation at birth may be considered as due to genetic factors. Deficiencies of various sorts and environmental differences will result in increased variation, due to nongenetic factors. The other side of the coin is that in a genetically homogeneous population all of the variation is due to environment. *These statements apply to populations of individuals, however.* When the question is the determination of a given *individual's* characteristics, we have to say that *at no time is an individual free from either factor.* Thus, when we consider complex functions such as intelligence, it can never be determined conclusively whether a particular individ-

ual's intelligence is mostly inherited or mostly a result of his particular environment.

Postnatal development is also the result of a complex interaction between genetic and environmental factors. In normal circumstances, with adequate nutrition and stimulation, the course of development will appear as an orderly sequence of events. Some individuals are slower or faster than the average, but the order of events within an individual is usually the same (see the last section of this chapter), and the development of such skills as talking and walking seems to be mainly caused by maturation of the neural and muscular structures necessary to support such activity. In several American Indian tribes, for example, babies are typically strapped to the backs of their mothers and, consequently, are quite restricted in moving about. These children, however, do not seem to be retarded in walking. They begin to walk at the appropriate time.

On the other hand, some studies have shown that children raised in environments in which there are few objects to explore with vision and touch and few sounds to hear may show at least temporary retardation in the development of information-seeking skills—i.e., actively exploring new things. Such retardation, if persistent, could result in difficulties in later learning.

In summary, the limits within which gene action and its effects on structure and behavior can operate, and the extent to which variations within these limits may be produced by environmental influences, are questions for which there are no definitive answers at present. Some of the answers may be a very long time in coming because of the many, many complex steps intervening between the operation of DNA and the structure, behavior, and experience of an individual. Nevertheless, some rather gross demonstrations of the role of hereditary characteristics in psychological processes, and, in some cases, of the complexities of hereditary and environmental interactions, may be made. These demonstrations are the subject of the next section.

The study of the inheritance of behavioral characteristics has progressed rapidly in the last few years. The field has come to be known as *behavior genetics*. Investigators in the field have developed several methods for studying behavioral inheritance, and their application has made it more and more clear that heredity plays a significant role in behavior.

Inheritance of Psychological Characteristics

METHODS

How does one go about studying the influence of heredity on psychological characteristics? Theoretically, the methods are the same as those for studying any other psychological question, and are based on the principles elaborated in Chapter 2. In particular, both correlational and experimental procedures have been used, depending upon the suitability of the method to the particular problem and species studied. Grossly speaking, one may distinguish two sets of factors which, operating together in some way, account for the behavior of the individual. These factors are, on the one hand, hereditary dispositions, and, on the other, environmental character-

istics. Study of the operation of these factors in behavior requires that both sets be brought under control.

Correlational Methods. Correlational study has been quite informative in questions involving human behavior, which is fortunate, since controlled breeding would meet with opposition from various quarters. Basically, the approach is to determine the extent to which a given behavioral characteristic (e.g., intelligence, or some personality characteristic) is predictable from knowledge of genetic and environmental similarities and differences. Studies of identical twins, who are genetically alike, versus fraternal twins, who are no more alike than brothers and sisters, have proved to be quite useful, especially in cases in which the twins were reared in different environments. The extent of genetic similarity can also be inferred from closeness of kin (immediate family versus cousins, grandparents, etc.) and this information used to predict psychological characteristics.

Experimental Methods. Experimentation has also been done with animal subjects. Here the approach is to hold heredity constant and manipulate the environment, or vice versa. Heredity in lower animals can be held constant through inbreeding, in which so-called *pure lines* are developed. Although not completely identical, same-sexed litter-mates within pure lines are about as similar genetically as could be achieved without the use of identical twins. Various lines and sublines of rats, mice, hamsters, guinea pigs, etc., have been developed for these purposes. Environment can be held constant by exercising extreme control over living conditions, food, and handling.

For purposes of illustration four examples of research dealing with inheritance of behavioral characteristics will be described. The examples include the inheritance of learning ability in rats, hereditary factors in human intelligence, the inheritance of emotionability, and hereditary factors in personality disorders.

INHERITANCE OF LEARNING ABILITY

R. C. Tryon (1942), of the University of California, started with a group of 142 rats, which he trained in a maze to see how many errors they would make in going through it. He divided them into a "bright" and a "dull" group on the basis of their scores. Next he bred bright rats with other bright rats and dull rats with dull rats, otherwise treating all animals exactly the same. In order to be sure that their environments were the same, he even had bright mothers raise foster litters of dull rats, and vice versa. He continued this pattern of breeding for a number of generations. The results are shown in Figure 3.3. As you can see, with each succeeding generation the separation between the bright and the dull rats was increased.

This experiment indicates rather clearly that something about learning a maze can be inherited. Exactly what is inherited is another question. Later experiments (Searle, 1949) have shown that the so-called maze-dull animals were not dull in other respects, nor were the maze-bright animals *generally* bright. Apparently, a particular pattern of capacities is inherited,

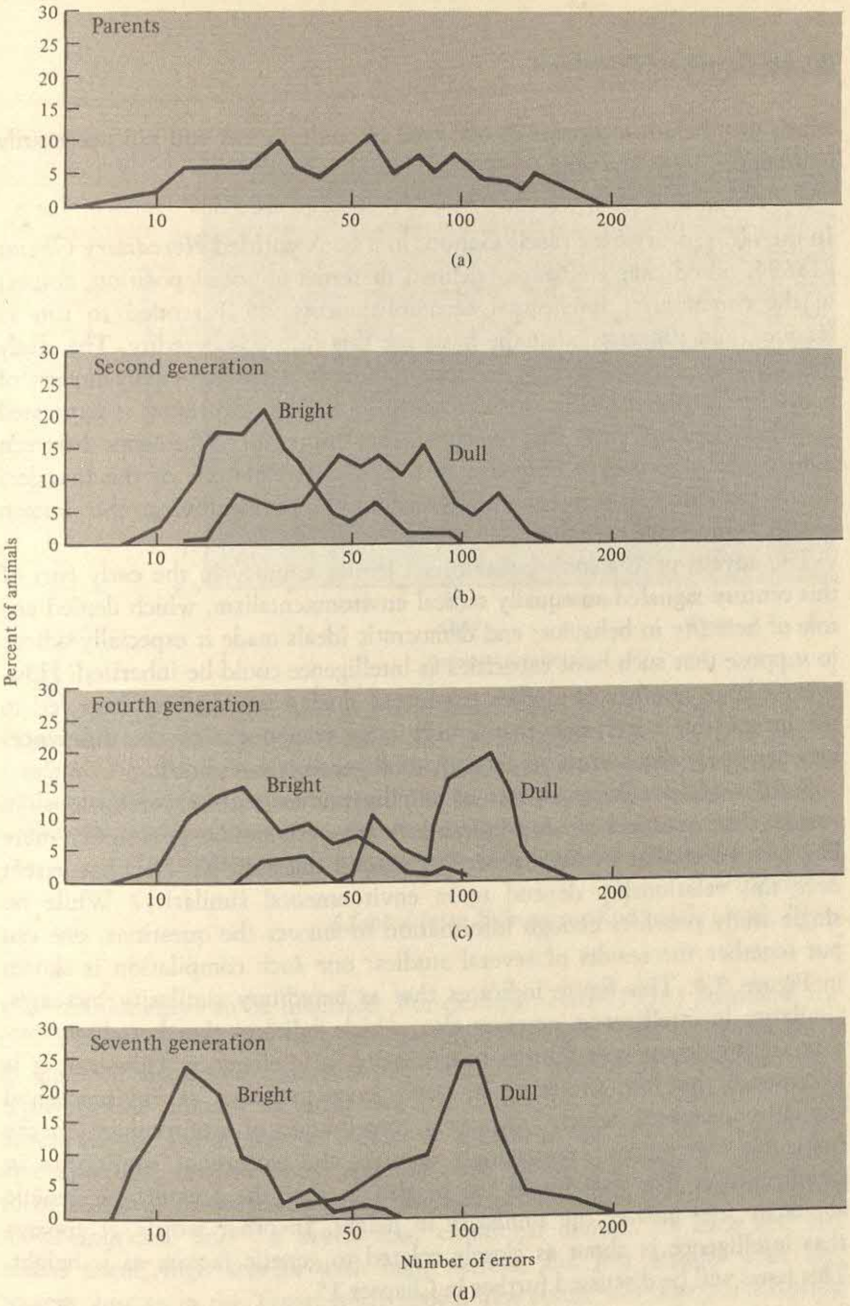

FIGURE 3.3

The effect of selective breeding on performance in a maze. (a). The distribution of errors in the group of parent animals. The ordinate (vertical, or y axis) indicates the percentage of the animals making a given number of errors. The number of errors is indicated on the abscissa (horizontal, or x axis). Note the rather wide distribution of errors. (b) Two generations later. Bright animals, making few errors, had been mated with bright animals, and dull animals, making many errors, with dull animals for two generations. Note that the distributions are tending to separate. (c) The fourth generation. Note the increased separation of the two groups. (d) The seventh generation. The two groups are practically distinct now. Adapted from Tryon, 1942.

which may be advantageous in one type of environment and not necessarily in others.

INHERITANCE OF INTELLIGENCE IN HUMANS

In the last century Sir Francis Galton, in a book entitled *Hereditary Genius* (1869), noted that eminence (defined in terms of social position, respect in the community, intellectual accomplishments, etc.) tended to run in families, and suggested that the basis for this fact was heredity. The study was certainly inconclusive by modern standards, since the environments of people in the same family would tend to be similar. However, it expressed a rather popular view that most of the important differences between individuals were due to heredity. In fact, Galton was one of the founders of the eugenics movement, which is aimed at improving the human species by selective breeding.

The advent of Watson's behaviorism in this country in the early part of this century signaled an equally radical environmentalism, which denied any role of heredity in behavior; and democratic ideals made it especially odious to suppose that such basic capacities as intelligence could be inherited. However, a large number of studies conducted during this century have led to the inescapable conclusion that a very large component of the differences between individuals with respect to intelligence is hereditary.

Studies of hereditary aspects of intelligence have been correlational in nature. The question is: Are individuals who are similar genetically more likely to be similar in intelligence? A related question is: To what extent does this relationship depend upon environmental similarity? While no single study provides enough information to answer the questions, one can put together the results of several studies; one such compilation is shown in Figure 3.4. This figure indicates that as hereditary similarity increases, similarity in intelligence increases also, which indicates that hereditary factors are important contributors to similarity in intelligence. However, it is also noted that the similarity in intelligence increases as environmental similarity increases, which indicates a contribution of environment to the individual differences. Interestingly enough, the pattern of similarities in intelligence is like that found for height, in that the greater the genetic similarity, the greater the similarity in height. In other words, it appears that intelligence is about as closely related to genetic factors as is height. This issue will be discussed further in Chapter 15.

EMOTIONALITY

Emotionality refers to an individual's tendency to react strongly to novel or threatening situations. Part of the reaction in humans may be experienced as fear, but other effects occur too, including changes in the autonomic nervous system (see Chapters 4 and 13). Several studies including both humans and animals have suggested that emotionality is at least partly hereditary. There should be no question about this point if one would just consider, for example, the difference in emotionality between, say, a chihuahua and an English setter, or a wild gray rat and a domesticated white rat. However, even within a single strain of animals, studies have shown

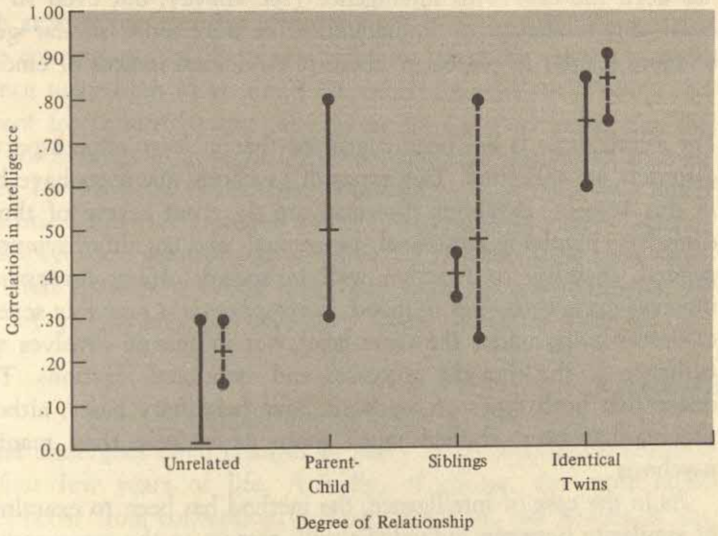

FIGURE 3.4

Similarity in intelligence and degree of genetic relationship. The ordinate is the correlation between pairs of individuals, and the abscissa is the degree of genetic relationship. The dashed lines are for individuals reared together, while the solid lines are for individuals reared apart. The extreme of each line indicate the range of correlations found in different studies, while the dash across each line indicates the median correlation obtained. (The median is the middle score in a distribution.)

Adapted from Erlenmeyer-Kimling & Jarvik, 1963.

that emotionality can be inherited. For example, Hall (1938) measured the emotionality of rats in a so-called open field situation. That is, he put them in an open space and observed their reactions, measuring emotionality in terms of the amount of urination and defecation that occurred. (These measures have been taken as indices of emotional reactions in a number of investigations, and the open field has been shown in a number of studies to be stressful to some strains of rats and mice.) Then he took the seven most emotional and the seven least emotional animals of each sex and mated them, high scorers with high scorers, and low scorers with low scorers, just as in the Tryon study above. The result was that the offspring of the emotional animals were considerably more emotional than those of the unemotional animals, and these differences were enhanced in successive generations.

There is also some evidence that emotional reactivity in human beings is partly hereditary. Jost and Sontag (1944) found that various physiological indices of emotional response (galvanic skin response, respiration and pulse rates, salivation) in children were more similar in the case of identical twins than they were for siblings, with the least similarity found between unrelated children. The overall similarity was much lower than

has been the case with intelligence (see above), but even so there was a consistent tendency for individuals who were more similar genetically to be more similar in respect to these physiological indices of emotion.

PERSONALITY DISORDERS

For a long time it has been suggested that at least some aspects of mental disorders are inherited. Two types of psychotic disorders have been studied in this respect. Psychotic disorders are the most severe of the personality disorders, involving emotional, perceptual, and cognitive symptoms and, in general, inability to function well in society. *Manic-depressive psychosis* involves extreme swings in mood. *Schizophrenia* is probably several different disorders going under the same label, but in general involves a severe disturbance in the thought processes and emotional reactions. There is evidence that both types of psychosis have hereditary bases, although schizophrenia has been studied much more extensively than manic-depressive psychosis.

As in the case of intelligence, the method has been to examine the extent of similarity between individuals with respect to the symptoms in question and see to what extent the similarity is related to genetic similarity. As you might expect, identical and fraternal twins have been widely used. In such studies the measure used to indicate similarity or difference with respect to the illness is *concordance*. The basic procedure is to find as many sets of twins as possible, at least one of whom is schizophrenic. Then the question is: Given that one of the twins is schizophrenic, what is the probability that

TABLE 3.2 *The results of several twin studies on the incidence of schizophrenia and other related disorders in pairs of twins*

Investigator	*Number of Pairs*[a]	*Schizophrenia*[b]	*Other Severe Disorders*[b]	*Normal or Only Mild Disorder*[b]
Essen-Moller	9	0	8	1
Slater	37	18	11	8
Tienari	16	1	12	3
Kringlen	45	14	17	14
Inouye	53	20	29	4
Gottesman & Shields	24	10	8	6
Kallman	174	166	62	9
TOTAL	358	103	147	4.5
Percent	100	46.4	41.1	12.5

Source: After Heston, 1970.

[a] Total number of twin pairs, one of which was diagnosed as schizophrenic.

[b] Incidence of schizophrenia and other disorders in the other member of the pair.

the other one will be schizophrenic also? In other words, of, say, 100 pairs of twins with at least one member schizophrenic, how many of the remaining twins are concordant, i.e., have schizophrenia also? In one such study the concordance turned out to be almost 70 percent for identical twins and only 15 percent for fraternal twins. The figure for fraternal twins was the same as that for siblings in general. Other studies have not found so high a concordance for identical twins, but, nonetheless, it is still very much higher for identical than for fraternal twins. The results of several studies with identical twins are summarized in Table 3.2. It should be clear from these results that there is a strong hereditary basis for schizophrenia, although it is not known how the hereditary factor or factors operate.

Growth and Development

Physical Growth and Maturation

The individual undergoes rapid changes in many of his anatomical features during the first few years of life. Actually, of course, the most rapid changes of all occur from conception to birth. However, the process is not too much slower after birth. For example, a child will attain half of his adult height before the end of his second year, while the final height will not be attained until sometime after puberty. It may be as early as 14 in the case of some girls and as late as 23 or 24 in the case of some boys.

The growth rate is not the same for all bodily parts. The head grows very rapidly at first and then slows considerably, while the trunk grows

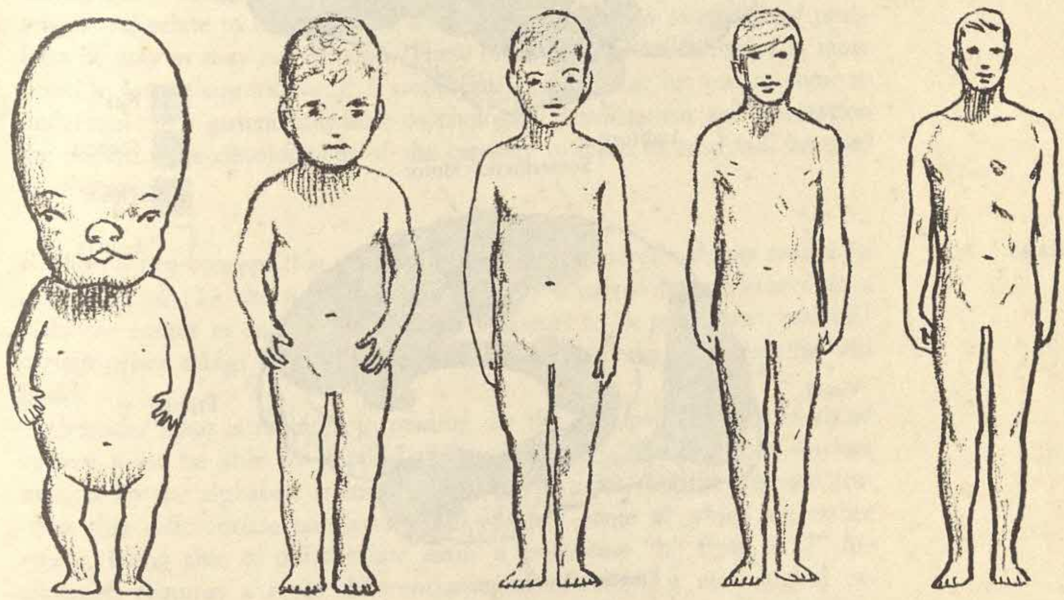

FIGURE 3.5

Changes in the relative sizes of the various body structures, beginning on the left with a 2-month-old fetus, and ending on the right with a mature adult.

more slowly. The legs and arms are even slower. Parts that show a growth spurt early may stop early. The result is the changing proportions seen in Figure 3.5.

Growth is not without its problems. Children undergoing rapid growth are often quite clumsy. The reason is that precise movements require continuous information coming into the brain as to where the various parts of the body are. When sizes change rapidly, the brain must adjust to the new information coming in, and this adjustment takes time.

Tissues within the interior of the body also develop at different rates. The brain, for example, has all of the cells it is going to have by the time the individual is born. The cells may change in size, efficiency of functioning, and length and complexity of the fiber connections to other cells, but no new cells are developed after birth.

Within the brain, the areas serving four of the primary senses (touch, vision, hearing, and taste) and the area most directly involved in muscle

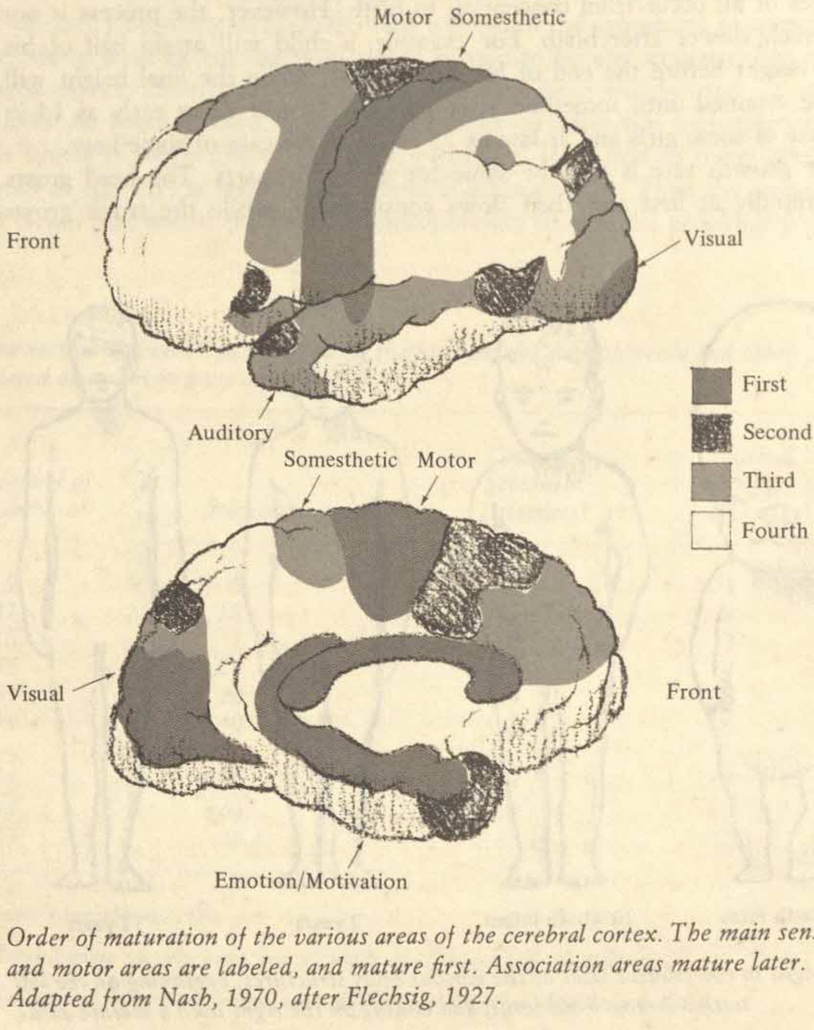

FIGURE 3.6 *Order of maturation of the various areas of the cerebral cortex. The main sensory and motor areas are labeled, and mature first. Association areas mature later. Adapted from Nash, 1970, after Flechsig, 1927.*

movements (see Figure 3.6 and Chapter 4) mature first. The last to mature are the so-called associative areas, which are presumably involved in more complex cognitive and intellectual functionings. The electrical activity of the brain also undergoes systematic changes that extend over a long period of time. The pattern of activity characteristic of the adult is not developed until about age 10.

One would expect that psychological functions such as the ability to control the bodily parts would mature in a way which is somewhat in correspondence with physical maturation, and such seems to be the case. Maturation proceeds in two directions at once. First of all, in keeping with the differential growth rate, control of the head matures before control of the lower parts of the body. Thus the direction is *cephalo-caudal* (head-to-tail). Second, both growth and maturation of control over the bodily parts proceeds from the body axis outward to the extremities, or in a *proximo-distal* direction. In Figure 3.7 is depicted the sequence of development leading to walking and to grasping an object. Note the gradual development of control from head downward, and from the body axis outward. Figure 3.7 also illustrates a third principle of development—the shift from *gross* movements to finely *differentiated* movements.

Maturation, and Psychological Growth

As the individual moves through childhood and into adulthood, he undergoes psychological changes that parallel his physical and physiological growth. These changes are perceptual, motor, cognitive, emotional, and motivational. They have many important ramifications that determine, among other things, how well he will be able to do the work required in school and relate to his peers and adults, and what types of emotional problems he may or may not develop. These processes will be discussed in more detail in later chapters, but it is important at this point for you to come to understand in a general way how psychological development and maturation are related. The development of the capacity to learn to read will be used as an example.

READINESS

Readiness is a concept that deals with the fact that certain things cannot be learned until (1) the neuromuscular systems involved have matured to a sufficient extent to enable the required behaviors to be performed, and (2) certain other things have been learned, upon which the new learning will build.

Consider what is required in reading. At the perceptual level, the visual system must be able to respond differentially to the different characters making up the alphabet. It must be capable of extracting the relevant features that differentiate one letter from another, some of which are rather subtle. Being able to differentiate easily a lower-case "b" from a "d" for example, requires a rapid differentiation of direction, a neurological capacity that does not mature in some children until after age 6, when reading is usually begun. Other differences are easily detected, such as between a "T" and an "O."

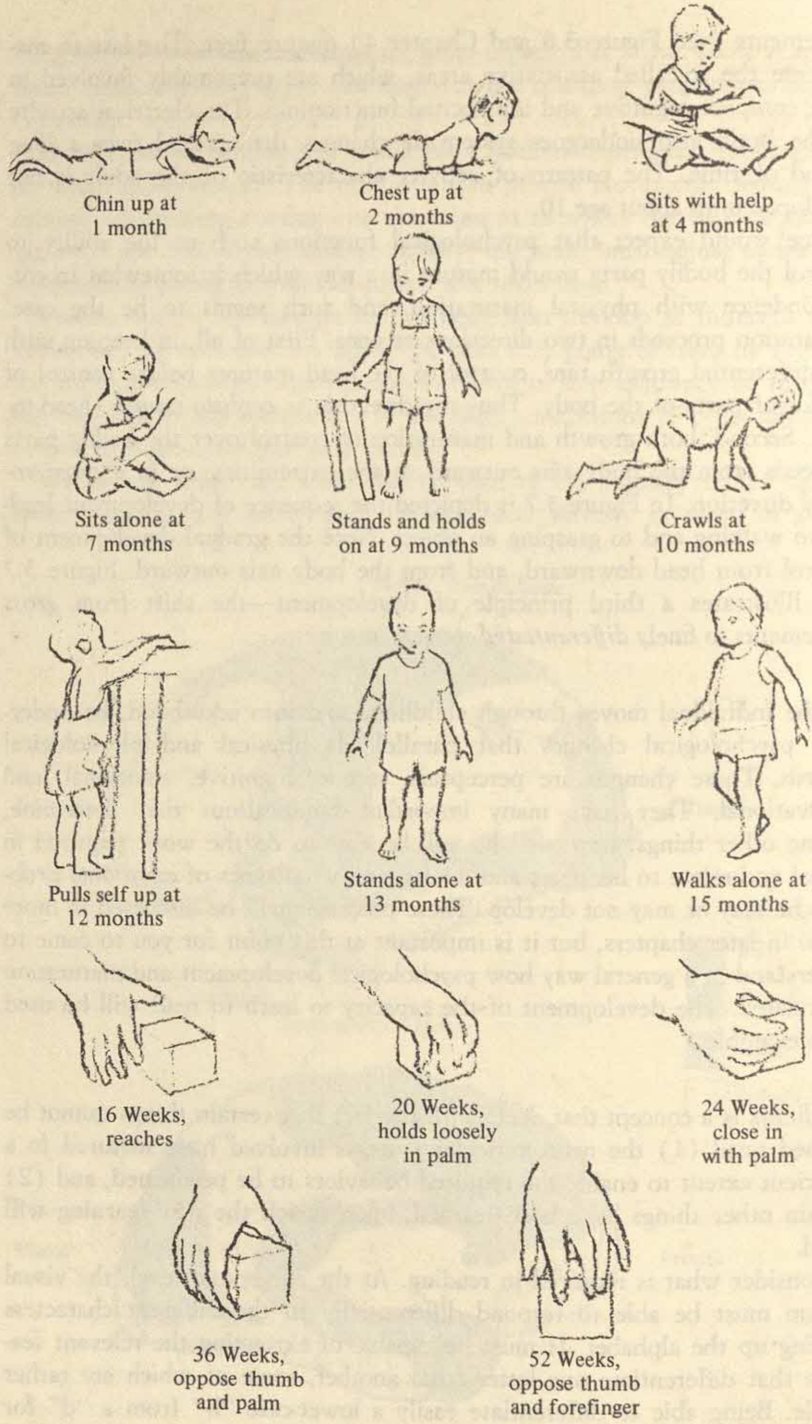

FIGURE 3.7 *Development of walking and grasping. (a) Developmental sequence in walking. (b) Developmental sequence in grasping an object. Although different children may begin these behaviors at different ages, the sequence remains the same. (a) adapted from Shirley, 1931; (b) adapted from Halverson, 1931.*

The motor system must have matured to the extent that the child can control his eye movements in a rather precise way. Direction is again quite important, since English is read from left to right and not any other way. Some children's motor systems mature more slowly than others, and it is quite possible that a relatively bright child will have trouble learning to read because his nervous system has not matured to the extent that he can control his eyes well enough.

Language must have been learned. The child must have acquired a good grasp of the language as heard before he can be expected to make any sense at all out of written characters. This ability has usually been long since learned in normal children, but deaf children or children with undiagnosed hearing disorders will have difficulty in learning to read.

One's attention span must be sufficiently long so that he can remember enough of what he has just heard or read to integrate it with what he is hearing or reading in order for it to make sense to him. Children differ widely in attention span, partly because of differences in maturation, and partly because of differences in emotional responsivity and motivation. Both previous learning and maturation play important roles here.

Finally, if one is to read and understand well, all of the above processes must be integrated into a continuous, smoothly functioning whole. Failure in any of the relevant components can make reading a very difficult and unpleasant task for a child. For instance, if a child has a developmental problem in control of the eye musculature, due to late maturation, he will probably have difficulty in learning to read. It will also be quite unpleasant, and perhaps even painful to him, and will no doubt affect his ability to read at a later age, even after the problem has cleared up. It would make more sense to try to determine if a child is neurologically ready to read before pushing him into it. If he is not mature, then one should wait for the proper maturational steps to occur, or, if some pathological condition is found, take specific steps to remedy it before attempting the training.

EFFECTS OF STIMULATION AND DEPRIVATION

Although certain kinds of learning cannot take place until the nervous system has matured sufficiently, there is evidence that the amount of prior stimulation is one determiner of the rate of maturation. Experimental studies have employed either deprivation or enriched environments and observed the effects upon the brain. Subjecting rats to an enriched early environment, for example, results in an increase in brain weight (Rosenzweig, Krech, & Bennett, 1962) relative to cage-reared controls, and Levine & Albert (1959) have shown that myelination of the central nervous system (CNS) is enhanced by early manipulation of rats. Myelin is a fatty substance surrounding the nerve fiber, and the amount of it is an indication of the state of neurological maturation. While these results are not without their qualifications (i.e., questions such as optimal times of stimulation have been raised), they do indicate that stimulation has important consequences for neurological function.

Stimulus deprivation also has its effects. Riesen (1958), for instance,

found that prolonged visual deprivation in chimpanzees resulted in degeneration of the retina, and less prolonged deprivation resulted in difficulties in learning to discriminate visual patterns. Held and Bauer (1967) deprived baby monkeys of the opportunity to see either their right or their left hand for a period of time and found a resulting deficiency in the ability to make smooth visually guided reaching movements.

Numerous studies have been conducted in which children reared in orphanages have been compared in intellectual development with those reared in foster homes or other more stimulating circumstances. Nash (1970) has reviewed this literature, including some of his own observations, which generally tends to show intellectual deficits in the impoverished circumstances. Nash feels that the impoverished children may be permanently deficient in making various kinds of perceptual integrations necessary for later development:

> It is as if the institution-reared child has a restricted range of effective vision. He sees only what is directly fixated and what is specifically attended to. Hence, incidental or latent learning is restricted. Moreover, the range of relevance is reduced too because he tends to perceive only what is immediately relevant (pp. 221–222).

Some psychologists argue that the effects of deprivation are reversible. However, whether or not this is the case cannot be determined without doing *experiments* in which infants are systematically deprived or not for varying periods of time. For ethical reasons such experiments will probably never be done.

In summary, then, psychological growth is a complex product of physical and physiological maturation and learning, in which new learning is built upon a foundation of a developmentally ready neuromuscular system, which, in turn, is affected by previous stimulation.

Summary

Behavior and experience are partly the expression of the biological nature of the organism. Evolution is an important concept in that, through natural selection, different animals have evolved different behavioral processes that promoted survival. These processes are transmitted from parent to offspring through genetic processes,

The physical basis of inheritance lies in the structure of the *genes,* which are found in the *chromosomes* in the *nucleus* of all cells. There are 23 pairs of chromosomes in the cells of the human being, one-half of them contributed by the mother and one-half by the father. The genes contain deoxyribonucleic acid (DNA), which provides the information necessary to specify the structure of enzymes (complex proteins) which in turn con-

trol the rate of the various chemical reactions taking place throughout the body.

Some characteristics, such as eye color, depend on only one gene, and the phenomena of *dominance* and *recessiveness* are seen. Sex is determined by one particular chromosome provided by the male parent. An X chromosome produces a female, a Y chromosome a male. Some other characteristics, such as color blindness, are *sex-linked,* in that they are determined by genes located on the X or the Y chromosome.

Genes differ in *penetrance,* or in the extent to which their expression is modifiable by environmental variations or by the presence of other genetically determined processes. Ordinarily, the interaction between genetic and environmental factors is quite complex, and one is never independent of either influence.

The inheritance of psychological characteristics, including some forms of learning ability, intelligence, emotionality, and certain personality disorders has been fairly well established. Methods used to study the inheritance of psychological characteristics may be either correlational or experimental. In either case, the extent to which variation in behavior is seen to go along with genetic or environmental variation is determined.

Postnatal growth and development is the product of both physical and physiological maturation and learning. Different parts of the body mature at different rates, with the process moving in two directions at once. Development is *cephalo-caudal,* progressing from head to tail; and also *proximodistal,* progressing from the body axis outward. Psychological growth is a process of new learning building upon a foundation of maturation and previous learning. The maturation and previous learning determine the *readiness* of the individual for new learning. Readiness is quite important in the acquisition of such skills as reading and writing; premature efforts to teach such skills will not be very rewarding, and may be harmful.

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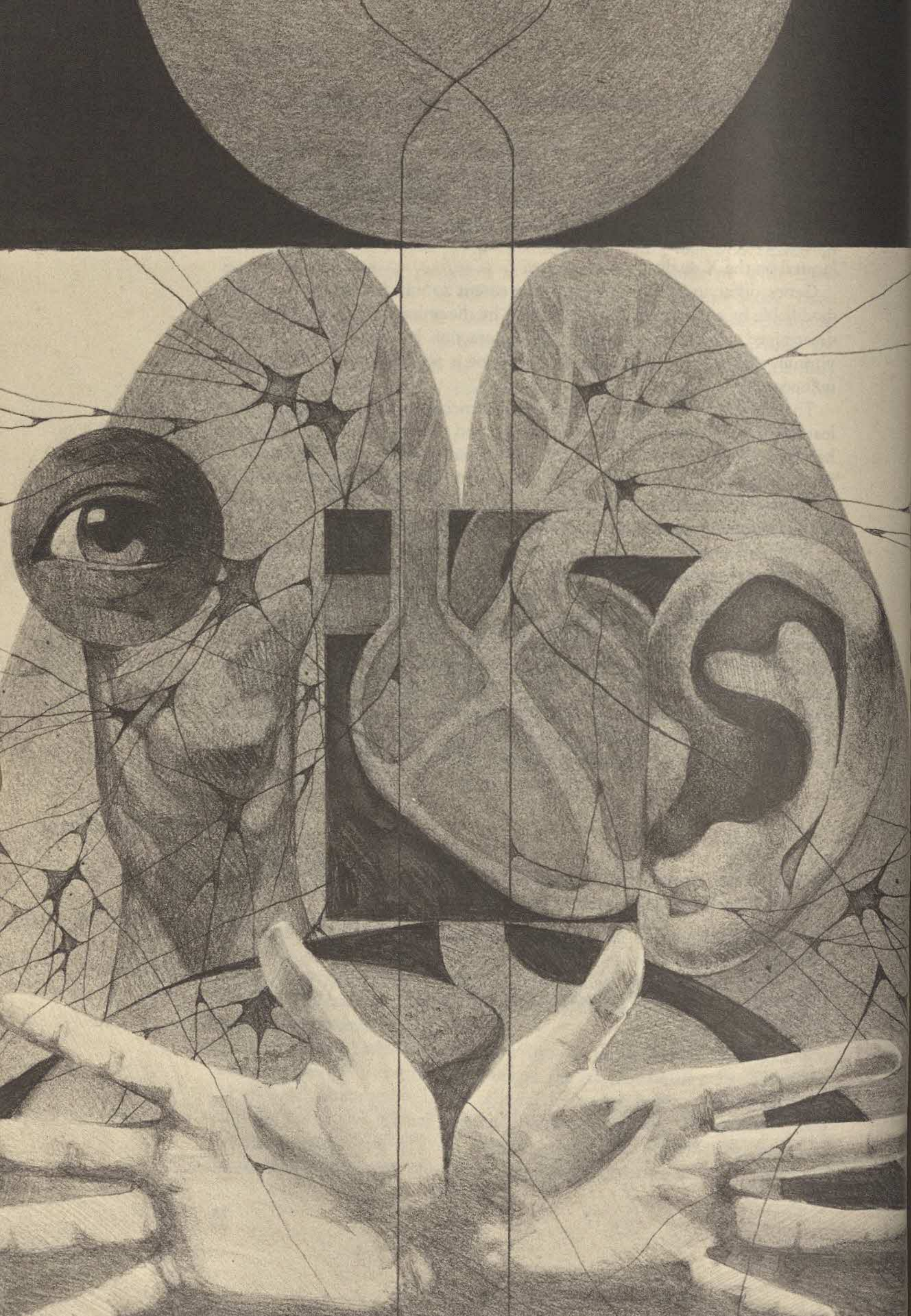


The Nervous System and Behavior

4

As pointed out several times in the previous chapter, behavior and experience are manifestations of biological processes. In this chapter these processes will be discussed in more detail. The first section will describe the basic units that underlie all behavioral processes—receptors, nerves, muscles, and glands—and will try to show you how they are interrelated in their functioning. In the next section you will encounter the larger anatomical units, which are the basic subdivisions of the nervous system. Finally, in the last section you will see something of how these structures operate in perception, motivation and emotion, thinking, and learning.

Basic Elements

Organisms are composed of cells, and complex organisms such as animals are composed of cells that are highly specialized for different functions. We shall consider four basic types of cell: receptors, neurons, muscle cells, and secretory cells. Because cells are organized into tissues, and tissues into organisms, and neither cells nor tissues ever function in isolation, our description will be somewhat artificial; however, the properties of individual cells must be regarded as responsible for the functioning of tissue, just as tissues are somehow responsible for the functioning of the organism. Therefore, the cell is the place to begin.

Receptors

Receptors are specialized to register physical energy. The process is called *transduction*, whereby raw physical energy produces a response in the recep-

tor. The receptor's response, in turn, sets up activity in the nervous system. Receptors may be subdivided on the basis of the type of energy that is transduced, and several types are shown in Figure 4.1.

As you are reading this page, the information you are receiving is coded into patterns of light, and will be effective for you only if your *photoreceptors* are functioning. Photoreceptors are located in the eyes of vertebrates, although other organisms may have additional organs that are sensitive to light. Photoreceptors function by absorbing light energy, which in turn triggers a chemical reaction in the cell. This chemical reaction then causes a reaction in the neuron associated with the receptor.

Mechanoreceptors are sensitive to mechanical energy from vibration, pressure, and movement. Sounds, for example, are propagated by means of vibrations in the air molecules, which in turn cause vibrations in the structures of the middle and inner ear. The receptors for sound, when vibrated, respond by producing an electrical current. Other mechanoreceptors in the inner ear respond whenever you move. Excessive or unusual stimulation of these receptors may in some people produce dizziness and motion sickness. Ordinarily, these cells keep the nervous system informed as to what kinds of movements are being made. Mechanoreceptors located in the skin respond electrically when deformed, providing the basis for the sensation of touch. Still other mechanoreceptors are located internally—e.g., within the walls of certain arteries. These receptors are important in sensing changes in blood pressure.

Chemoreceptors are, as you might expect, sensitive to changes in the chemical environment. You are most familiar with the chemoreceptors located on the tongue, which provide for the sense of taste, and those located in the upper reaches of the nasal cavity, which are responsible for smell. Some animals, such as fish, have chemoreceptors located all over their bodies, and still others have them located on antennae. There are also chemoreceptors located within the body that are sensitive to chemical changes in the blood stream. Hunger and thirst, for instance, are partially dependent upon chemoreceptors located within the hypothalamus (discussed later) of the brain, which register changes in certain important chemicals such as glucose (a type of sugar) and salt.

The basic subdivisions above imply that receptors are specialized to transduce *particular kinds* of energy, which is true. On the other hand, all of them will respond to *strong* stimuli of various kinds. Electric shock, for example, is a universal stimulus. Under ordinary conditions, however, cells mostly respond to the energy for which they are specialized.

Neurons

ANATOMY

Information from receptors is transmitted to neurons which are specialized to conduct information from one part of the body to another. There are many different types, one of which is shown in Figure 4.2. All neurons have three parts in common, however. The *cell body* contains the nucleus and various other parts that keep the cell alive and supplied with energy. *Dendrites* are the short filamentous processes attached to the cell body. Many axons are

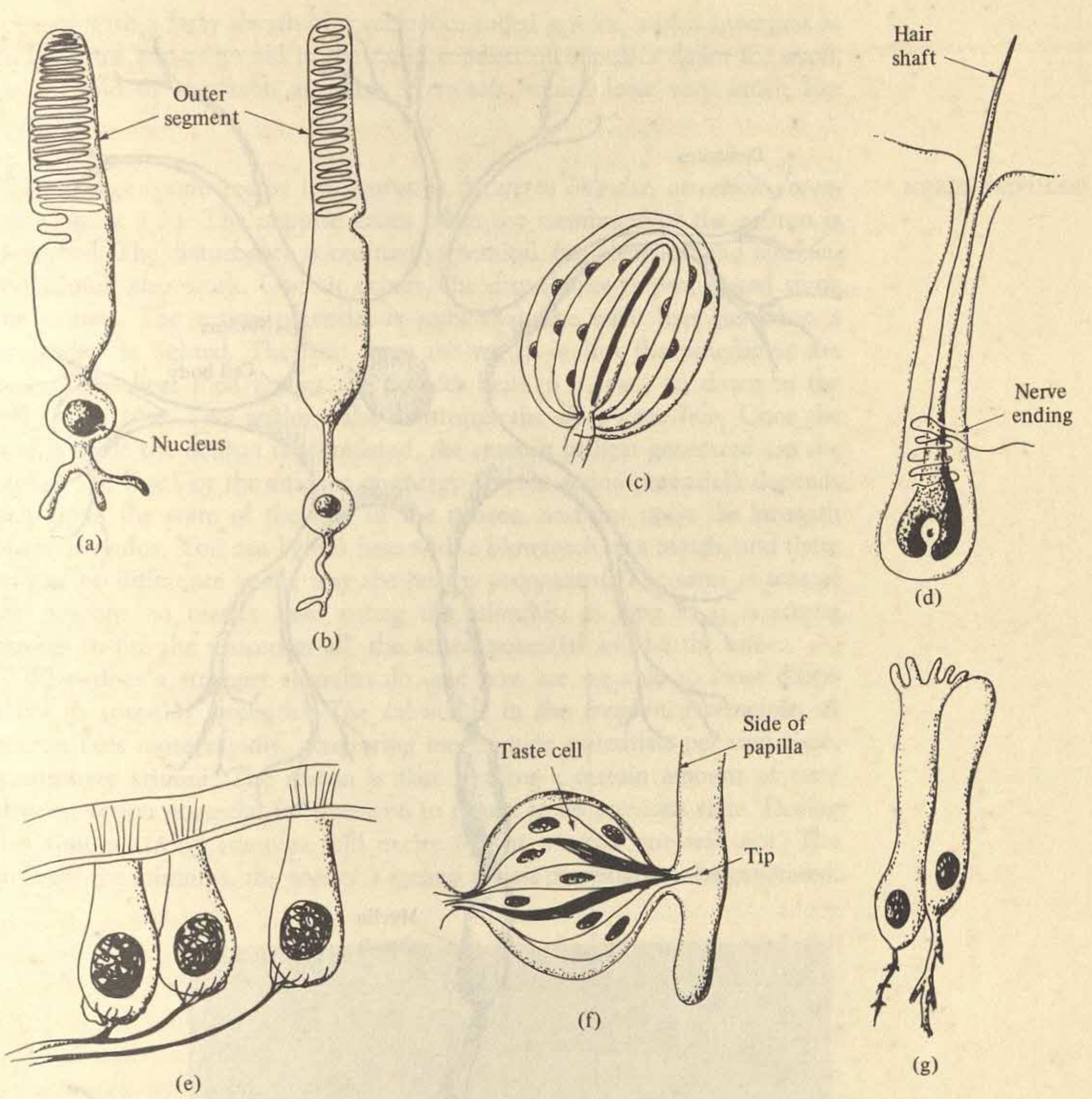


FIGURE 4.1

Examples of photoreceptors, mechanoreceptors, and chemoreceptors. (a) A cone from the retina. (b) A retinal rod. The light is absorbed in the layered outer segments, which contain pigments. (c) A Pacinian corpuscle from the depths of the skin, a receptor that responds to deep pressure. (d) A basket ending around a hair, from the surface of the skin. The ending responds when the hair is moved. (e) Hair cells from the Organ of Corti, which is the auditory receptor organ. The hair projects into a membrane overhead and, when the hairs vibrate, the hair bends and generates an electric current. (f) A taste bud, containing taste cells. The hairlike tips of the cells sample the fluids flowing over the surface of the tongue and down the sides of the papillae. (g) Olfactory cells. The hairlike projections at the end of the cells (microvilli) sample the contents of the air flowing past. (a), (b) From Dowling & Boycottt, 1966; (e) from Gulick, 1971; (f) from Woodworth and Marquis, 1947.

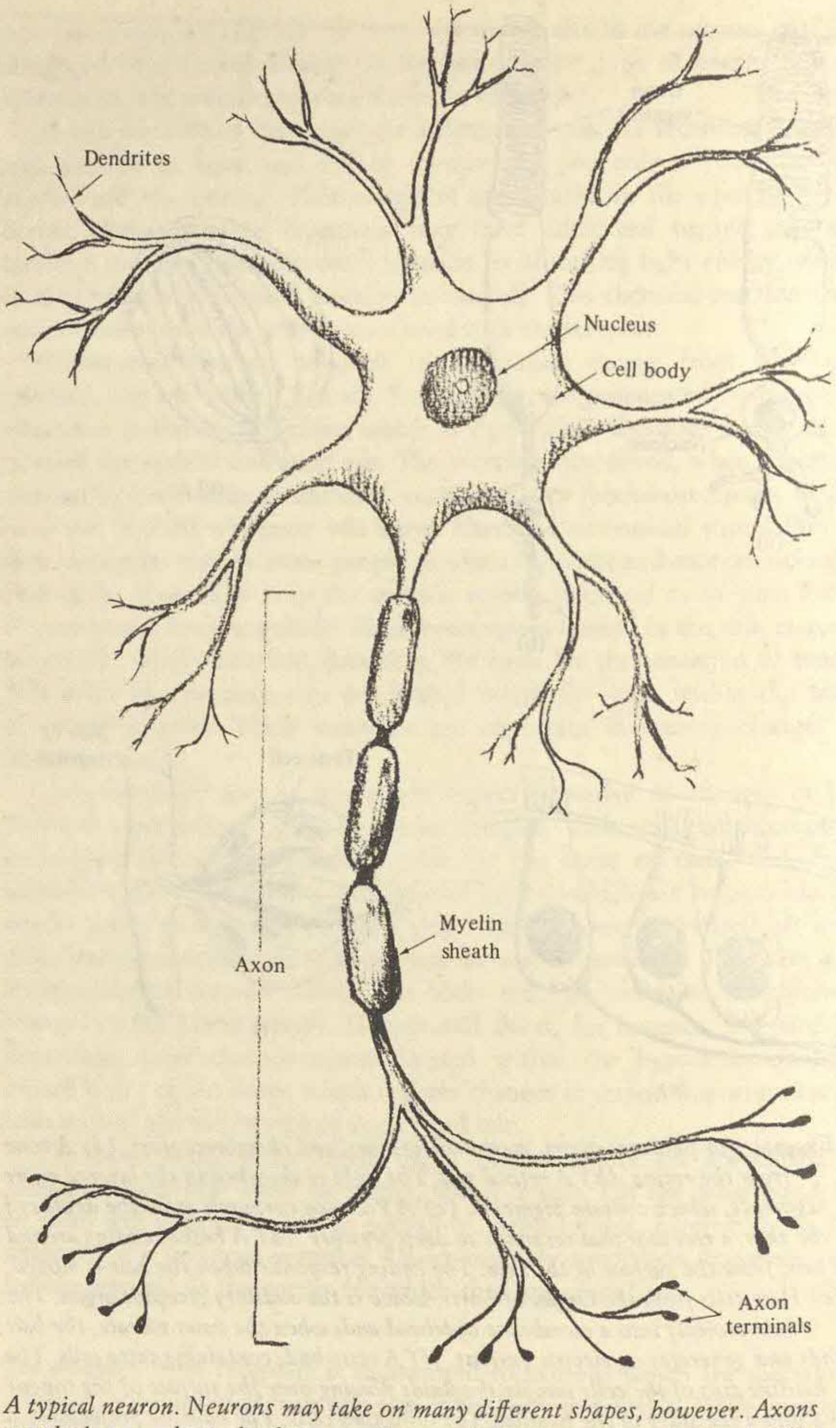


FIGURE 4.2 *A typical neuron. Neurons may take on many different shapes, however. Axons may be long or short; dendrites may be very elaborate or relatively simple. This diagram, then, is intended only to show the basic parts of the neuron.*

covered with a fatty sheath of a substance called *myelin*, which functions as an insulator and as an aid in the rapid conduct of impulses down the axon. At the end of the axon are *axon terminals*, which look very much like dendrites.

NERVE IMPULSES

The message conducted by the neuron is the *nerve impulse*, or *action potential* (Figure 4.3). The impulse arises when the membrane of the neuron is disturbed. The disturbance is ordinarily chemical, but electrical and mechanical stimuli also work. Once it occurs, the disturbance is propagated along the neuron. The action potential is somewhat like what happens when a firecracker is lighted. The heat from the match ignites the powder at the end, whose heat then ignites the powder next to it, etc., on down to the end of the fuse. This analogy also illustrates the *all-or-none law:* Once the fuse is lit or the neuron is stimulated, the amount of heat generated (in the case of the fuse) or the amount of energy (in the action potential) depends only upon the state of the fuse or the neuron, and not upon the strength of the stimulus. You can light a fuse with a blowtorch or a match, and there will be no difference in the way the heat is propagated. The same is true of the neuron: no matter how strong the stimulus, as long as it is strong enough to fire the neuron at all, the action potential will be the same.

What does a stronger stimulus do, and how are we able to sense differences in stimulus strength? The answer is in the *frequency principle:* A neuron fires more rapidly, generating more action potentials per unit time, to stronger stimuli. The reason is that it takes a certain amount of time after an action potential for a neuron to return to its previous state. During this time a strong stimulus will excite it, but a weak one will not. The stronger the stimulus, the sooner a second action potential can be generated.

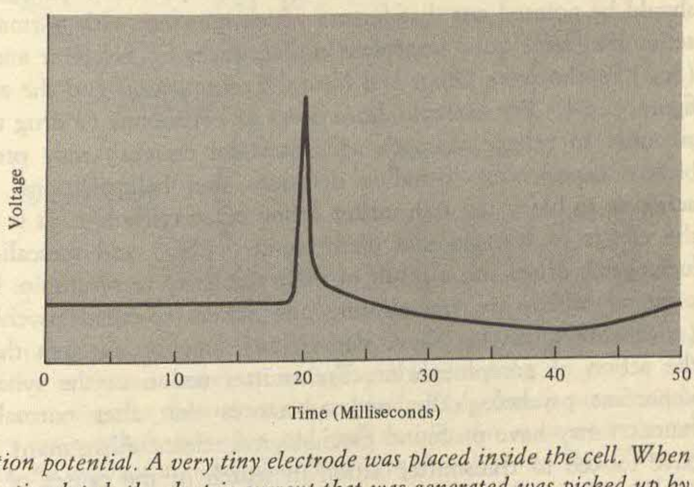


FIGURE 4.3

A nerve action potential. A very tiny electrode was placed inside the cell. When the cell was stimulated, the electric current that was generated was picked up by the electrode and amplified and displayed on a cathode ray tube (an instrument somewhat similar to a television screen). The height of the line indicates the voltage, and the horizontal distance indicates time.

SYNAPSES

How does one neuron communicate with another? The connection between one neuron and another is called a *synapse*. The axon terminals of the first neuron in a chain come very close to the dendrites or to the cell body of the second neuron (see Figure 4.4). A action potential in the first, or *presynaptic* neuron is propagated along the axon to the axon terminals. At this point a small amount of a chemical substance, called a *transmitter*, is released from the presynaptic axon terminal. The chemical diffuses across the gap separating the two neurons, and reacts with the membrane of the second, or *postsynaptic* neuron. If enough action potentials reach the postsynaptic neuron during a brief period of time, then the postsynaptic neuron will fire also.

Some synapses are *excitatory*, in that the presynaptic neuron will stimulate the postsynaptic neuron to fire more rapidly. Other synapses are *inhibitory*, causing the postsynaptic neuron to fire more slowly. Thus what happens in a postsynaptic neuron depends upon the balance of excitation and inhibition at its synapses.

In actual fact, the synaptic connections of one neuron are often quite complex and may involve thousands of other neurons. In other words, a given neuron may receive information from many different presynaptic neurons and may in turn connect to many postsynaptic neurons. Given that there are about 10 billion neurons in the brain, you can see how complex the picture might be.

TRANSMITTERS

The chemical transmitters that make the actual synaptic connections are of interest. There are several different transmitters. One is *acetylcholine*. Another is *norepinephrine* (closely related to a chemical with the more familiar name of adrenalin), and a third is *serotonin*. While study of the biochemistry of transmitter substances is beyond the proper scope of this book, it should be pointed out that factors which interfere with normal transmitter action may have quite important consequences for behavior and experience. (See "Psychoactive Drugs and Neural Transmitters" and the accompanying figure, p. 84.) For example, large doses of belladonna (a drug used in small amounts to relieve stomach and intestinal cramps) may produce rather bizarre experiences, including delusions and hallucinations. Belladonna's action is to block the transmitter action of acetylcholine. It is thought that the effects of lysergic acid diethylamide (LSD) and mescaline, two hallucinogenic drugs, are a result of their similarity to serotonin. Other drugs, some of which are tranquilizers and others so-called psychic energizers (which are taken to relieve depression) function through their effect on the action of norepinephrine. Transmitter action at the synapse is quite important psychologically, and substances that alter normal transmitter function may have profound psychological effects. Also, many investigators have looked to transmitter action in search of the causes of various personality disturbances in the hope that some rather simple biochemical abnormality may be found. Thus far, no conclusive findings have been produced.

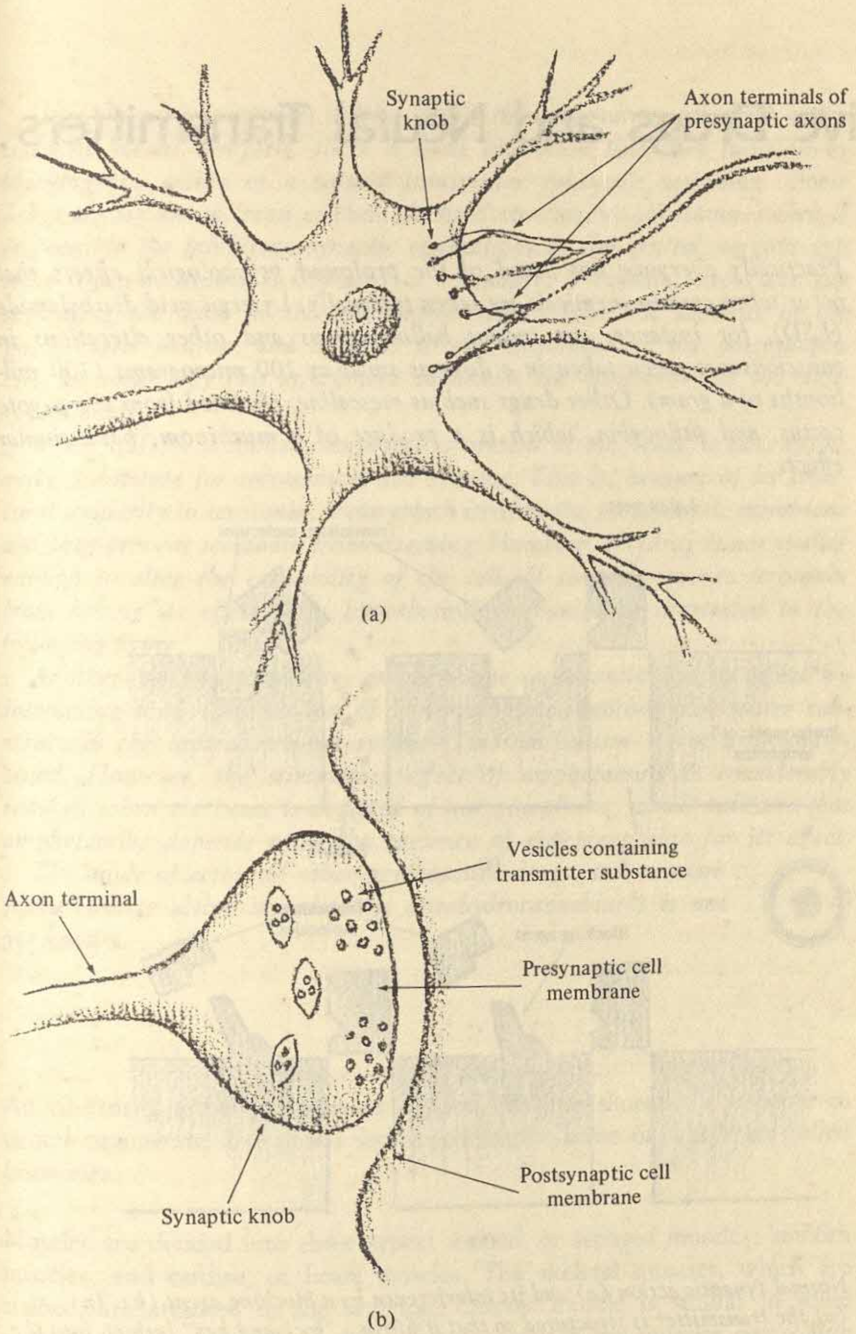


FIGURE 4.4

The synapse. (a) shows the cell body and dendrites of a postsynaptic neuron and their relation to the axon terminals and synaptic knobs of the presynaptic cell. The knobs are swellings on the ends of the terminals. They contain mitochondria, which carry out metabolic processes, and small vesicles that contain transmitter substance. An enlarged drawing of a synaptic knob is shown in (b). When an action potential reaches the knob, the transmitter vesicles burst open and the substance contained in them is released to flow across the gap to the postsynaptic membrane.

Psychoactive Drugs and Neural Transmitters

Practically everyone has heard of the profound psychological effects that occur when certain chemicals are taken internally. Lysergic acid diethylamide (LSD), for instance, can induce hallucinations and other alterations in consciousness when taken in a dose as small as 100 micrograms (100 millionths of a gram). Other drugs such as mescaline, obtained from the peyote cactus, and psilocybin, which is a product of a mushroom, have similar effects.

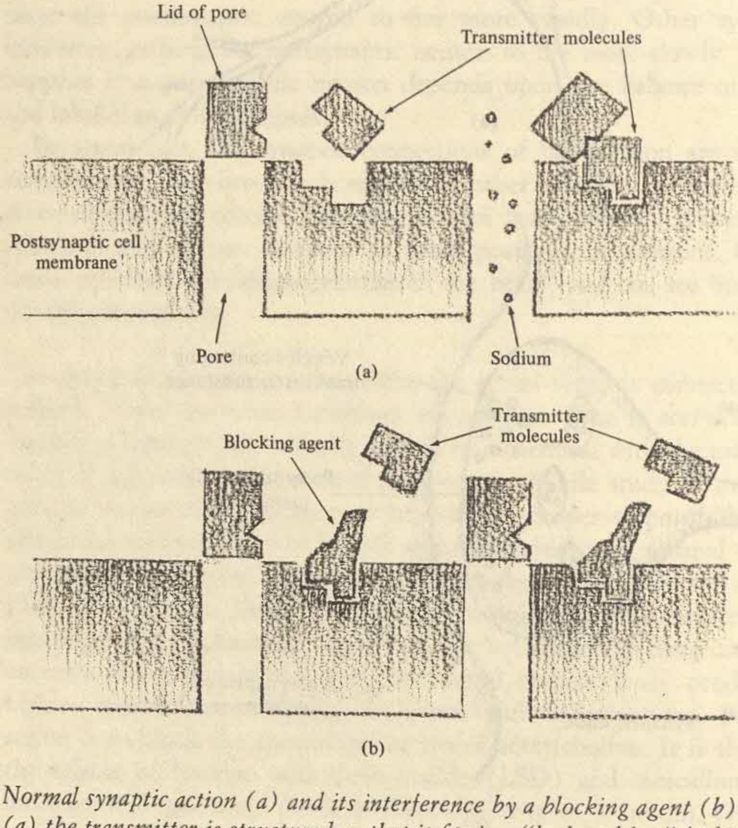


FIGURE A *Normal synaptic action (a) and its interference by a blocking agent (b). In (a) the transmitter is structured so that it fits in a "lock and key" fashion into the slot in the postsynaptic cell membrane and, when it fits in, it can open the pore which will permit sodium ions to rush into the cell, which can initiate an action potential. In (b) the blocking agent (e.g., belladonna, LSD) resembles the transmitter in part so that it can occupy the site that would ordinarily be occupied by the transmitter. However, its structure is not such that it can cause the opening of the pores in the membrane. Therefore, its function is to prevent the transmitter from occupying the postsynaptic membrane sites, and therefore synaptic activity is inhibited.*
Adapted from Eccles, 1964.

How do such substances work? While the explanation for their action is by no means complete, there is some indication that they function by blocking the action of a natural transmitter substance serotonin. *These drugs are similar in terms of their chemical structure to serotonin, which is responsible for inhibitory synaptic connections in the central nervous system. When serotonin is liberated at a synapse, it diffuses across the gap separating the axon of the presynaptic neuron from the dendrite of the postsynaptic neuron, and attaches to the membrane of the postsynaptic cell. In some way this attachment influences the excitability of the postsynaptic cell.*

When LSD or a similar compound is present in the brain, it can, apparently, substitute for serotonin at the synapse. That is, because of its structural similarity to serotonin, it can attach itself to the postsynaptic membrane and thus prevent serotonin from attaching. However, the drug is not similar enough to alter the excitability of the cell. It simply prevents serotonin from having its effect. This hypothetical mechanism is illustrated in the following figure.

Another psychoactive drug, amphetamine, apparently has its effect by interacting with the function of norepinephrine, another transmitter substance in the central nervous system. This mechanism is not well understood. However, the stimulating effect of amphetamine is considerably reduced when the brain is depleted of norepinephrine, which indicates that amphetamine depends upon the presence of norepinephrine for its effect.

The mode of action of other psychoactive drugs such as marijuana (whose active ingredient is tetrahydrocannabinol) is not yet known.

Effectors

An effector is either a muscle or a gland. Muscles shorten in response to neural commands, and glands secrete chemicals, some of which are called *hormones.*

MUSCLES

Muscles are divided into three types: striped, or striated muscles; smooth muscles; and cardiac, or heart muscles. The skeletal muscles, which are striped, are attached to the skeleton. Cardiac muscle is similar in some respects to striate muscle. Smooth muscles include the muscles controlling the shape of the lens of the eye and the size of the pupil and the muscles of the intestines. Striped muscles respond precisely with quick, strong movements in response to voluntary action, while smooth muscles are for the most part involuntary, and their response is slower. On the other hand, recent experiments have showed that individuals can, through operant training procedures (Chapter 7), gain control over smooth muscles. As will be seen later, the two types of muscle are mostly under the control of two different divisions of the nervous system: (1) the skeletal muscles under

the so-called somatic division, and (2) the smooth muscles under the autonomic nervous system.

The transfer of information from nerve terminals to muscle fibers is similar to the transfer of information at the synapse. A transmitter chemical is liberated by the nerve terminal, which causes the muscle fiber to twitch or shorten. The transmitter for skeletal muscles and some smooth muscles is acetylcholine, while that for other smooth muscles is epinephrine, which is similar to norepinephrine.

GLANDS

Glands contain secretory cells that liberate chemicals. If the chemicals are secreted into some body cavity or onto a surface, e.g., saliva secreted into the mouth or sweat secreted onto the skin, the gland is said to be *exocrine* (the prefix *exo* referring to "out of"). *Endocrine* (*endo* = into) glands, on the other hand, secrete their chemicals into the bloodstream. We shall be mostly concerned with endocrine glands, since the *hormones* secreted by these glands affect behavior in a variety of ways. In Figure 4.5 are shown the major endocrine glands and some of their functions.

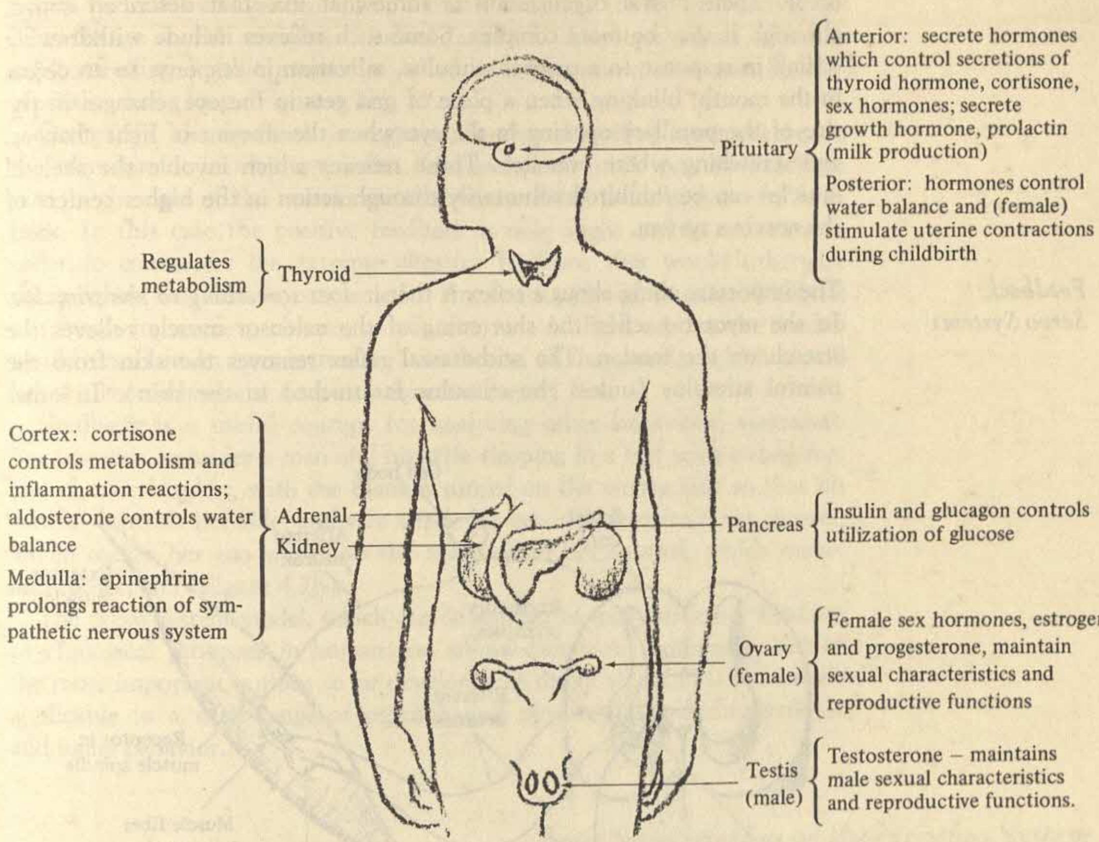
Glands respond to neural activity or to changes in some chemical in the bloodstream. For example, the adrenal medulla secretes epinephrine in response to activity in the sympathetic division of the autonomic nervous system. The hormone increases the heart rate and breathing rate, and has other effects which, in general, prepare the animal to respond to some dangerous situation. On the other hand, corticosterone, a hormone secreted by the adrenal cortex that reduces inflammatory reactions, is secreted mainly in response to changes in the level of ACTH (adrenocorticotrophic hormone) in the bloodstream. In turn ACTH is secreted by the pituitary gland, which is partly under neural control. It is secreted as a response to physiological or psychological stresses of various sorts.

Some hormones have rather specific actions upon sites within the nervous system and thereby affect behavior. For example, minute amounts of estrogen, a female sex hormone, when implanted into a very tiny area of the hypothalamus, will induce female cats into a prolonged state of sexual receptivity (Harris & Michael, 1964).

You can see that the relationship between the nervous system and the endocrine glands is quite complex; indeed, since they seem to function as a unit in so many ways, they are often referred to as the neuroendocrine system.

Simple Neural Integration: Reflexes

Receptors, neurons, and effectors do not function in isolation; they are *organized*. They make up a *system* that functions in a complex, but *integrated* way. How is this integration accomplished? How do these elements function together in behavior? Let us consider the simplest possible case—the reflex that occurs when the tendon below the knee-cap is tapped, the *knee jerk* (see Figure 4.6). It is called a *myotatic reflex*, or *stretch reflex*, because it responds to the stretching of a muscle tendon. The response is a tightening, or shortening, of the muscle involved. Only two neurons are



A composite male-female drawing of the main endocrine glands and their functions. Adapted from Bailey & Wagner, 1972. FIGURE 4.5

directly involved in this reflex. One of them is an *afferent* neuron (*ad*= toward; *fero*=carry), which carries information toward the central nervous system, in this case to the spinal cord. The other is an *efferent neuron* (*ex*= from), which carries information away from the cord. At the dendritic end of the afferent neuron is a mechanoreceptor in the muscle, called a muscle spindle. When the tendon is stretched by tapping below the knee cap, the muscle is also stretched, which activates the reflex. A synapse occurs in the spinal cord, and the efferent neuron is activated which, in turn, stimulates the muscle to contract. Shortening of the muscle relieves strain in the receptor.

You might expect that the release of strain would cause the receptor to stop firing and thus reduce tone drastically. However, a special muscle within the muscle spindle itself shortens so as to maintain stretch on the spindle, causing it to continue to fire during the contraction.

There are numerous other reflexes that are all essentially automatic in their function. You do not have to think about them in order for them to

occur. Their neural organization is somewhat like that described above, although it may be more complex. Some such reflexes include withdrawing a limb in response to a painful stimulus, salivation in response to an object in the mouth, blinking when a piece of grit gets in the eye, changes in the size of the pupillary opening in the eye when the amount of light changes, and scratching where you itch. Those reflexes which involve the skeletal muscles can be inhibited voluntarily through action in the higher centers of the nervous system.

Feedback: Servo Systems

The important thing about a reflex is that it *does something to the stimulus.* In the myotatic reflex the shortening of the extensor muscle relieves the stretch on the tendon. The withdrawal reflex removes the skin from the painful stimulus (unless the stimulus is attached to the skin). In other

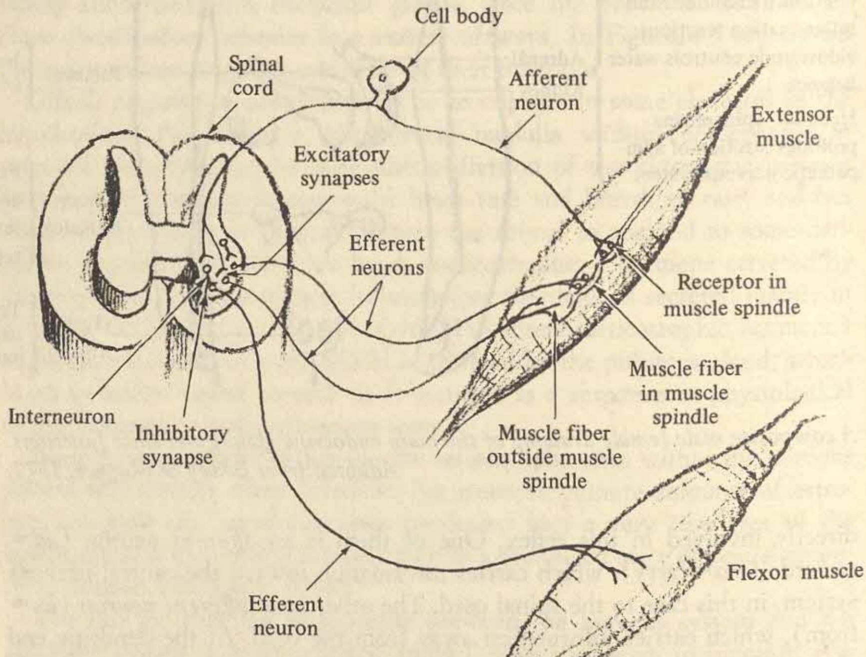


FIGURE 4.6 *A diagram of the stretch, or myotatic reflex. Stretching the extensor muscle causes the receptor to fire. The action potentials are conducted over the afferent neuron into the spinal cord, where two synapses occur. The first one, in relation to the efferent neuron supplying the extensor muscle, is excitatory, causing the extensor to shorten. The second synapse is upon a small neuron called an interneuron which, in turn, has an inhibitory synapse upon the efferent neuron which supplies the flexor muscle that is antagonistic to the extensor. The inhibitory synapse causes the neuron to fire less rapidly, and therefore causes the flexor to relax.*

words the reflex action removes or controls the cause for its own activation. This change in the stimulus is called *feedback*. A system whose action is self-controlling in this manner is called a *servo system,* and may be conceptualized as a loop (Figure 4.7a).

Ordinarily, the feedback is *negative,* in that the reflex action decreases the stimulus for its own activation. (An exception is the positive feedback seen in the case of the muscle spindle, whose firing is *maintained* by feedback. In this case the positive feedback is only slight and is necessary in order to counteract the extreme negative feedback that would otherwise occur when the muscle contracted.) An oversupply of positive feedback can result in severe problems, as you can see. A slight tap on the tendon would result in an ever-increasing contraction of the muscle, which would last until something else such as fatigue intervened.

Feedback is a useful concept for analyzing other behavioral situations. For instance, consider a man and his wife sleeping in a bed with a dual-control electric blanket, with the blanket turned on the wrong side so that his control controls her side, and vice versa. He gets cold, turns up the control, which makes her too warm, so she turns down her control, which makes him colder, etc. (Figure 4.7b).

The servo system model, which can be applied to many different kinds of psychological processes in human and animal behavior, is probably one of the most important notions to be developed in recent years. It is potentially applicable to a wide range of psychological phenomena including reflexes and social behavior.

Basic Subdivisions of the Nervous System

The nervous system is a complex network of neurons and other cells connected on the input side with receptors and on the output side with muscles and glands. There are various ways of subdividing it into parts. For example, the *central nervous system* consists of the brain and spinal cord, while the *peripheral nervous system* consists of everything outside the CNS. We may also differentiate between those structures containing many cell bodies (and, usually, many synapses) and those structures containing primarily axons. Groups of cell bodies within the CNS are called *nuclei* (not to be confused with nuclei contained *within* cells), while groups of axons are called *fiber tracts.* Within the peripheral nervous system, cell bodies are collected into *ganglia* and axons into *nerves.* By and large, the integrative action performed by the nervous system takes place where the synapses are, while the conducting of messages from one center to another is carried out by fiber tracts and nerves.

Except for the senses of smell and vision, all of the afferent information coming to the CNS is conducted over the peripheral nervous system.

While the central and peripheral systems are distinguished primarily as to their location, one other distinction is also important to mention. If a peripheral nerve is cut, it will probably regenerate if the cut is a relatively

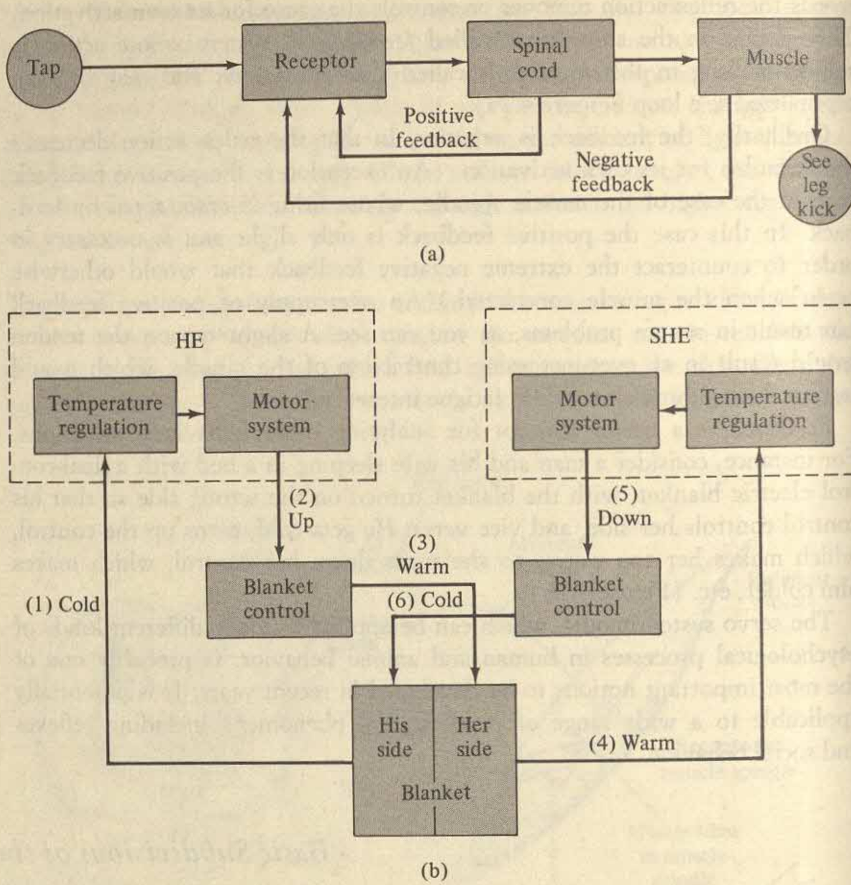
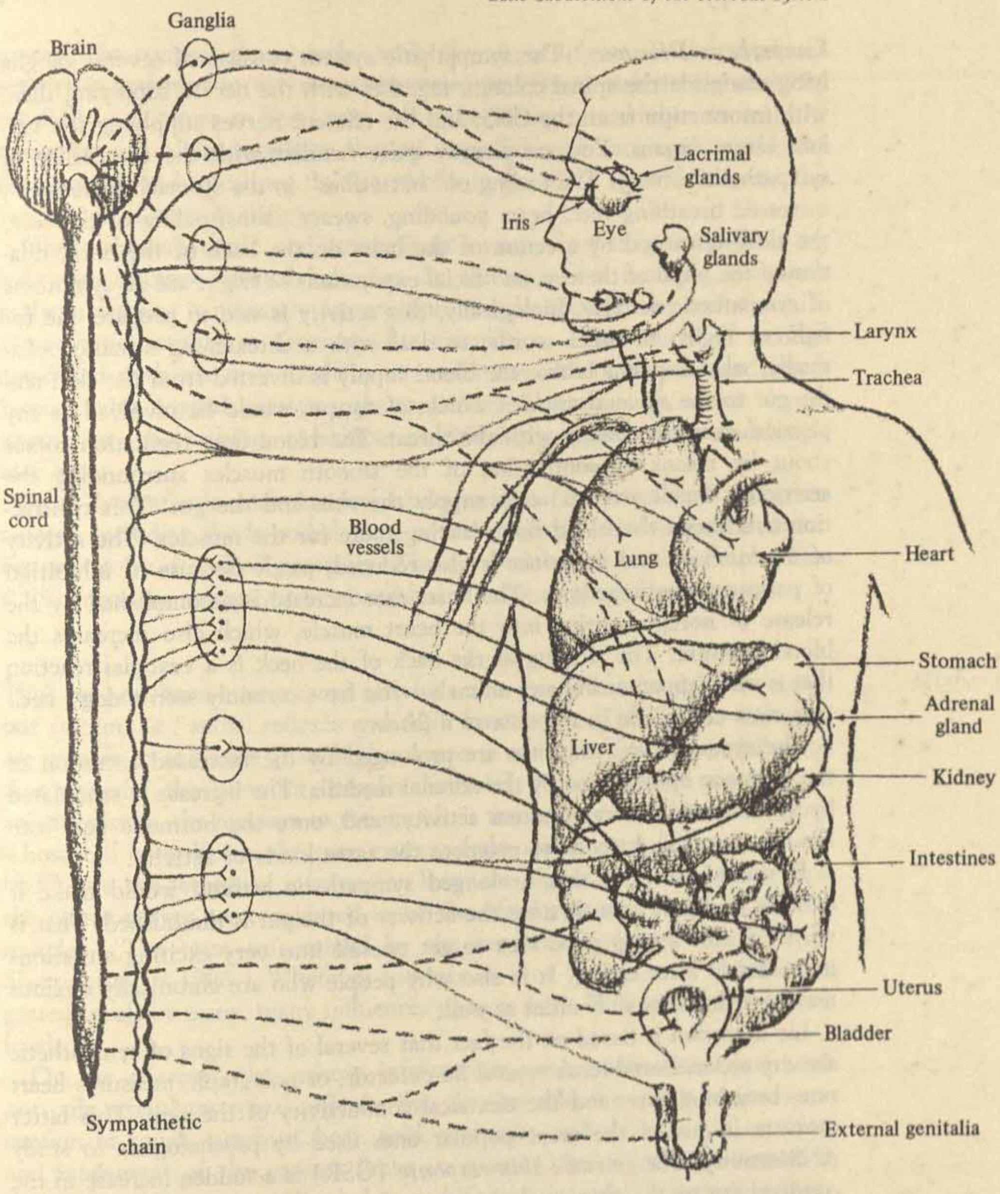


FIGURE 4.7 *Some feedback loops. (a) A block diagram of the stretch reflex described in Figure 4.6 (b) A block diagram of the positive feedback situation that develops when an electric blanket with dual controls is turned over the wrong way. The sequence of events begins with (1) he gets cold, and (2) turns the blanket control up. As a matter of fact, the sequence could actually start at any point, and the outcome would still be the same.*

clean one and the two ends are reasonably close together. If, however, a fiber tract in the CNS is cut, it will not regenerate. That is why a spinal injury is so serious. It could result in a permanent loss of function of parts of the body supplied by the tract.

Somatic and Autonomic Nervous Systems

Both the peripheral and the central nervous systems may be subdivided into *somatic* and *autonomic* components. The somatic component consists of those parts which subserve the various senses (i.e., vision, hearing, touch, taste, and smell) and which supply the skeletal musculature with its efferent information. Later in this chapter we shall discuss the anatomy of these systems further.



The peripheral branches of the autonomic nervous system. The sympathetic division (———) originates in the various ganglia making up the sympathetic chain alongside the spinal cord. The parasympathetic division (– – – –) originates in the cranial nerves (top) and in the sacral nerves (bottom). Note that most organs are innervated by both systems.

FIGURE 4.8

AUTONOMIC NERVOUS SYSTEM

The autonomic nervous system (ANS) is a self-regulating system that supplies the smooth muscles with their efferent information. It is further subdivided into the *sympathetic* and the *parasympathetic* divisions (Figure 4.8) (*Para=against*, so you might expect that they act somewhat in opposition, which is true).

Sympathetic Division. The sympathetic system consists of several ganglia lying alongside the spinal column, together with the nerves supplying them with information from the CNS, and the efferent nerves supplying the various target organs. You are already quite familiar with the experience of sympathetic activity. The feeling of "butterflies" in the stomach, jitteriness, increased breathing rate, heart pounding, sweaty palms, paling of the face, the tickling caused by erection of the hairs on the back of the neck, dilation of the pupil of the eye, and facial expressions of fright are all symptoms of sympathetic activity. Biologically, this activity is said to prepare one for fight or flight; in other words, to deal with a threatening situation. Basically, what happens is that the blood supply is diverted from the skin and the gut to the skeletal muscles which, of course, would be involved in any physical exertion dealing with the threat. The blood flow regulation comes about by means of contraction of the smooth muscles surrounding the arterioles (small arteries) that supply the skin and the gut. This contraction cuts down the blood flow, leaving more for the muscles. The activity of the stomach and intestines is also reduced, partly because of inhibition of parasympathetic activity. The heart rate increase is accomplished by the release of norepinephrine into the heart muscle, which also increases the blood pressure. The tickling at the back of the neck is a vestigial reaction that is more apparent in hairy animals—you have certainly seen a dog's neck or a cat's tail bristle in response to a threat.

The sympathetic symptoms are prolonged by the increased secretion of the hormone epinephrine by the adrenal medulla. The increase is stimulated by sympathetic nervous system activity, and, once the hormone gets into the bloodstream, it tends to promote the same kinds of activity.

It should be clear that prolonged sympathetic activity would make it difficult to digest a meal, since the activity of the gut is diminished. That is why it is not a very good idea to get oneself into very exciting situations immediately after eating. It is also why people who are chronically anxious may have digestive difficulties as well.

Lie detection is based on the fact that several of the signs of sympathetic activity are measurable. A typical lie detector, or polygraph, measures heart rate, breathing rate, and the electrical conductivity of the skin. This latter measure is one of the more popular ones used by psychologists to study ANS activity. The *galvanic skin response* (GSR) is a sudden increase in the conductivity of the skin to the passage of a small amount of electrical current (too small to feel), and is one of the accompaniments of a threatening or surprising stimulus. Unfortunately for the profession of lie detection, these physiological measures are not terribly reliable. They are subject to too many influences, in addition to whether or not a person is lying (which presumably would make him anxious). Thus the results of lie detection tests cannot be considered as conclusive evidence in court.

Parasympathetic Division. The *parasympathetic nervous system* consists of several nuclei located within the brain and spinal cord, and the peripheral

nerves that connect these nuclei with the target organs. Parasympathetic activity is involved in the more vegetative processes, such as digestion. It results in a decrease in heart rate and in breathing rate, and an increase in salivation and blood supply to the gut, together with increased motility of the stomach and intestines. It also results in pupillary constriction and the production of tears in the eye.

The parasympathetic and sympathetic systems act cooperatively in at least one instance—sexual behavior. In the male, for example, parasympathetic activity is necessary for erection and the secretion of semen, while sympathetic activity is necessary for ejaculation. High levels of anxiety associated with sex may result in increased sympathetic activity and interference with normal parasympathetic activity. Consequently, either sexual impotence (the inability to achieve an erection) or premature ejaculation may occur.

Both sympathetic and parasympathetic systems are controlled by higher centers, including the hypothalamus, which are structures within the *limbic system,* to be described presently. The cerebral cortex is also involved in ANS control, as indicated when one blushes in an embarrassing situation.

Higher Centers

Thus far you have encountered activities at a fairly low level in the nervous system, i.e., spinal reflexes and ANS functioning. These basic activities are subject to influence from higher centers, and it is this higher influence that provides the basis for complex behavior. Recall that, in the case of spinal reflexes, the message to the muscle is transmitted over a motor nerve, whose cell body lies in the gray matter of the spinal cord. These same cell bodies are the targets of information from the higher centers as well. Thus the motor nerves are considered to be the "final common pathway" to the muscles. (The term was coined by the famous physiologist Sir Charles Sherrington in 1906.) Whatever message is sent to a muscle is the integrated result of many, many influences upon it from both spinal and higher levels.

On the afferent side, sensory information coming into the spinal cord not only stimulates spinal reflexes, but also provides for the conscious perception of touch, pressure, heat, cold, and pain, and the sense of position and movement of the various limbs in space. Other afferent information does not reach awareness levels but contributes to various postural reflexes from higher centers. A description of some of these higher centers follows.

HINDBRAIN

Above the spinal cord is the *hindbrain,* which is further subdivided into the *medulla,* the *pons,* and the *cerebellum.* These structures are shown in Figure 4.9. The medulla and the pons contain centers that are important in maintaining breathing and controlling the heart rate. If they are damaged, then breathing may become quite irregular, or may stop entirely.

The cerebellum sits astride the pons, and contains centers responsible for coordinating movements. A patient with cerebellar damage may be able

to walk, for example, but he will do so quite clumsily, as though each muscle involved did not "know" what the other ones were doing.

MIDBRAIN

Above the hindbrain is the *midbrain,* which contains centers for vision and hearing. In lower animals such as the frog, the main brain centers for vision are located here. Also important in the midbrain is the *reticular formation,* which is responsible for maintaining the alertness of the higher neural centers. Stimulation of this structure will arouse a sleeping animal, and damage to the center results in somnolence.

FOREBRAIN

The *forebrain* is the highest structure. It contains the *hypothalamus* and the *thalamus,* as well as the *cerebrum,* which includes the *cerebral cortex* and certain other structures located just below the cortex.

Hypothalamus. The hypothalamus is quite important in controlling the autonomic nervous system and is also quite important in motivation and emotion. It contains centers that are sensitive to changes in the concentration of glucose, salt, and water in the bloodstream, which are responsible for initiating eating and drinking behavior. Other centers seem to be involved in the production or inhibition of rage reactions; still others are so-called "pleasure centers," since animals will work very hard to receive electrical stimulation in these areas.

Thalamus. The thalamus is quite closely tied in with the cerebral cortex, particularly those portions that are rather recent in their evolution (called the neocortex). All of the afferent connections to the neocortex are made by way of the thalamus. The only sensory information not passing through the thalamus is that from the sense of smell, which does not go directly to the neocortex but to brain areas that are much older.

Cerebral Cortex. The cerebral cortex is what you see when you look at the top surface of the brain. In higher mammals it is extensively folded in, consisting of fissures and convolutions. Lower mammals have smooth brains, and it is thought that the convoluted appearance of the higher brains is caused by the tremendous increase in surface area of the cortex, combined with a relatively smaller increase in the capacity of the skull to accommodate the tissue. Actually, if the human brain were smooth, the surface area would be more than one square yard, thus requiring a rather large head to accommodate it.

The cerebrum is divided into a left and a right hemisphere, and each hemisphere is further divided into four lobes, named according to the bones that lie over them. The lobes are the frontal, parietal, temporal, and occipital lobes. The *frontal cortex* contains a motor area as well as a large amount of tissue that seems to be associative in function (i.e., not directly involved in either sensory or motor processes but perhaps responsible for other kinds of activity such as thought, planning, etc.). The *parietal lobe* contains an area that receives sensory information from the body surface

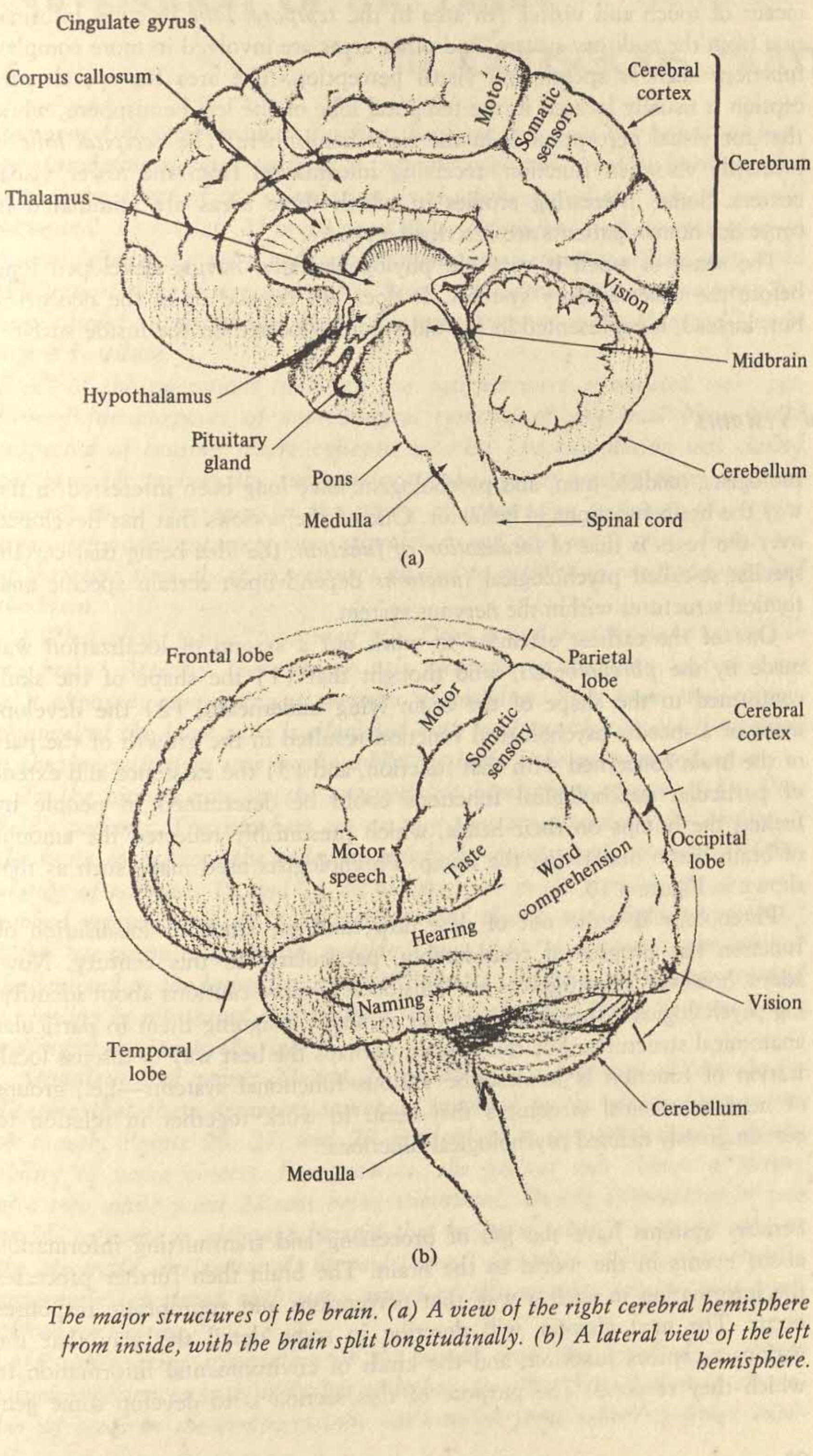


FIGURE 4.9 *The major structures of the brain. (a) A view of the right cerebral hemisphere from inside, with the brain split longitudinally. (b) A lateral view of the left hemisphere.*

as well as an associative area that is involved in the perception of shape by means of touch and vision. An area in the *temporal lobe* receives information from the auditory system, and other areas are involved in more complex functions such as speech and visual perception. The area for speech perception is usually located in the temporal lobe of the left hemisphere, while that for visual perception is in the right hemisphere. The *occipital lobe* is primarily visual in function, receiving information from the lower visual centers. Some interesting studies in which these areas are stimulated in conscious human patients are described on p. 97.

The sense of smell is very old phylogenetically, having developed long before the other sensory systems. It does not depend upon the neocortex but, instead, is represented in the older cortex located on the inside surface.

Functional Neural Systems

Biologists, medical men, and psychologists have long been interested in the way the brain functions in behavior. One of the notions that has developed over the years is that of *localization of function*, the idea being that certain specific so-called psychological *functions* depend upon certain specific anatomical structures within the nervous system.

One of the earliest attempts to work out a system of localization was made by the *phrenologists,* who thought that (1) the shape of the skull conformed to the shape of the brain lying underneath, (2) the development of a specific psychological function resulted in the growth of the part of the brain concerned with that function, and (3) the existence and extent of particular psychological functions could be determined in people by feeling the bumps on their heads, which presumably reflected the amount of brain tissue underlying the bump. Phrenologists used maps such as that shown in Figure 4.10.

Phrenology is quite out of date now, and the study of localization of function has progressed considerably, particularly in this century. Nowadays, however, investigators are considerably more cautious about identifying psychological "functions" as well as about assigning them to particular anatomical structures. For this reason, perhaps the best way to discuss localization of function is to describe various functional systems—i.e., groups of neuroanatomical structures that seem to work together in relation to certain grossly defined psychological functions.

Sensory Systems

Sensory systems have the job of processing and transmitting information about events in the world to the brain. The brain then further processes the information in such a way that perceptions and appropriate responses occur. The next chapter will describe in some detail the way that the various receptors function, and the kinds of environmental information to which they respond. The purpose of this section is to develop some gen-

Stimulation of the Brain in Conscious Human Beings

For over 100 years brain researchers have studied how the brain functions by stimulating various parts of it, usually with mild electric currents, and noting the effect of the stimulation on the behavior of the subject, usually an animal. In the last 25 or 30 years these techniques have been applied to human beings who were wide awake while being stimulated, and who could thus report their experiences while being stimulated. Most of this work has been carried out by Wilder Penfield, a neurosurgeon at the Montreal Neurological Institute.

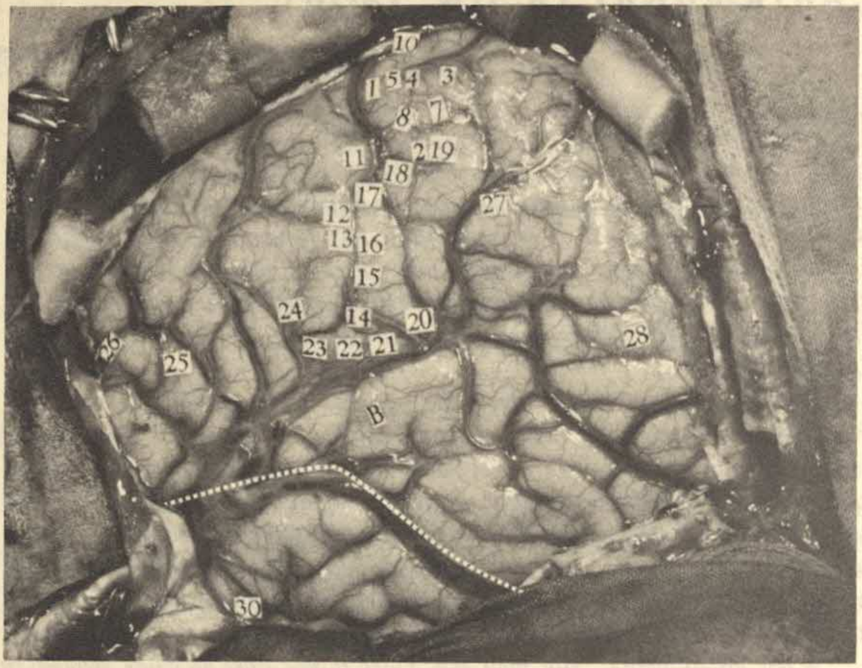
All of the operations in which the patients were stimulated were performed for purposes of neurosurgical removal of abnormal brain tissue suspected of causing severe epileptic attacks. The stimulation was carried out in order to help the surgeon locate the speech area in order to avoid damage to it. However, in the course of attempting to locate the speech area, many adjacent areas were stimulated, and thus much could be learned at the same time about experiences related to activity in particular parts of the brain.

"What about pain?" you may ask. Does it not hurt to poke around in the brain? Actually, there are no pain receptors in the brain, and so, once it is exposed, stimulating it presents no problem. Pain from the incision, removal of the bone, etc., is alleviated with local anesthesia, and the patient is thus permitted to stay awake while his brain is being operated upon.

In the picture you see the exposed left hemisphere of one of Dr. Penfield's patients. The numbers are on tags that are placed on the surface of the brain to indicate the order in which the points were stimulated. Stimulation of points 1, 19, and 14, all of which are in the somatic sensory area, evoked reports such as (1) "tingling right thumb and slight movement," (19) "sensation in lower lip, outside," and (14) "sensation in the joint of the jaw and in the lower lip, inside." Point 11, in the motor cortex, evoked a "feeling in my throat that stopped my speech," and Point 13 produced a pulling of the jaw to the right.

Stimulation of points 23 and 24 resulted in a blockage of speech, indicating that these areas are somehow involved in the motor components of speech. Points 26, 27, and 28 resulted in a temporary arrest in the ability to name objects. For example, the patient was shown a picture of a tree while point 27 was being stimulated. During stimulation he was unable to name it, although he said that he knew what it was. As soon as the electrode was removed; he said "tree." In other words, the stimulus apparently interfered with some aspect of the complex process that is required for naming.

In other areas stimulation of the visual areas has resulted in simple visual experiences such as flashes of light, stars, etc. Stimulation of a number of areas in the temporal lobe has evoked some rather complex expe-



Penfield & Roberts, 1959.

riences, which are often quite vivid. For example, one patient heard her small son "speaking in the yard outside her own kitchen," (p. 51) as well as neighborhood sounds. She reported that the experience was much stronger than a memory; it was more like reliving the original experience. This vividness, as though one were reliving a segment of his past history, is characteristic of these experiences from stimulation of the temporal lobe. Apparently, some portion of the biological substrate for memory is located there.

eral notions about how the nervous system functions in handling sensory information, and then to indicate some of the major features of the main senses of vision, hearing, touch, taste, and smell.

CODING

Environmental information must be coded by receptors into the language of the nervous system, which, as indicated before, consists of action potentials varying in frequency of firing. This information is transmitted to the brain over the various afferent nerves. It is not received by the brain in "raw" fashion, however. There are several synapses along the way to the brain (at least two in each case) at which further processing takes place. Since synapses are places at which, many, many neurons may interact, they seem to serve the function of extracting relevant features of the information

present at the receptor. For example, in the case of vision, information about *edges* seems to be particularly important, and recent research indicates that this edge information is extracted by means of particular kinds of synaptic interactions (Hubel & Wiesel, 1962).

AROUSAL

Another general feature of sensory systems is that sensory information goes to several different levels of the nervous system simultaneously, and thus may serve several different functions at once. For example, information from the skin, the eyes, and the ears; taste information from the tongue; and positional and movement information from the vestibule of the inner ear all go to the reticular formation (Figure 4.11). This information probably does not serve a perceptual function, but rather serves to *alert* the cerebral cortex and to maintain a certain level of *arousal* over the whole of the cerebral cortex. For this reason the term reticular activating system is used. When your alarm clock goes off in the morning, the information going from your auditory receptors to the reticular activating system is sent, *via* several nuclei in the thalamus, to the whole cerebral cortex to alert it that something is happening. This alerting can be monitored electrically by means of an electroencephalograph machine, which records the electrical activity of the brain (Figure 4.11). Only when the cortex is "awake," do you "hear" the alarm, i.e., respond perceptually to the information reaching the cortex over other afferent auditory systems.

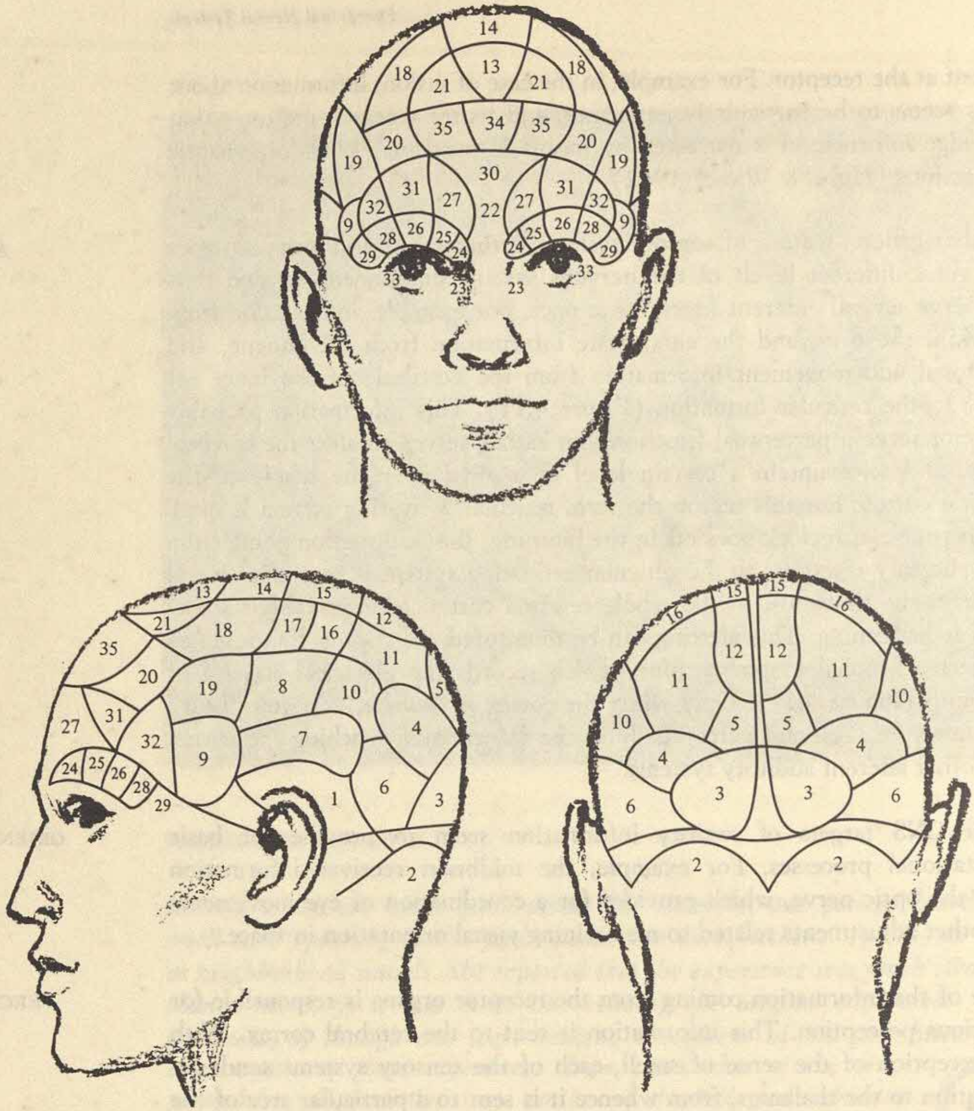
ORIENTATION

Other CNS targets of sensory information seem to provide for basic orientational processes. For example, the midbrain receives information from the optic nerve, which provides for a coordination of eye movements and other adjustments related to maintaining visual orientation in space.

PERCEPTION

Some of the information coming from the receptor organs is responsible for conscious perception. This information is sent to the cerebral cortex. With the exception of the sense of smell, each of the sensory systems sends information to the thalamus, from whence it is sent to a particular area of the cerebral cortex, depending upon which sense is involved. The areas receiving primary information from the skin, the eye, the ear, and the tongue are shown in Figure 4.11(b). From these primary receptive areas the information is sent to various associative areas of the cortex, where it is presumably integrated with other information, including that stored from past experience. It is also sent back to lower brain centers, where it may affect the way incoming information is handled and influence various motor adjustments that are important in perception. For example, movements of the eyeball are quite important in visual perception, and a visual stimulus off to one side will produce a definite tendency to move the eyes in its direction.

Regarding the senses of vision, touch, and hearing, one additional point may be made. In each case there is a relatively orderly representation of the receptor surface on the primary receptive area. The different parts of the body are represented in an orderly manner on the somesthetic cortex.



Affective Faculties		Intellectual Faculties	
Propensities	*Sentiments*	*Perceptive*	*Reflective*
? Desire to live	10 Cautiousness	22 Individuality	34 Comparison
* Alimentiveness	11 Approbativeness	23 Configuration	35 Causality
1 Destructiveness	12 Self-Esteem	24 Size	
2 Amativeness	13 Benevolence	25 Weight and Resistance	
3 Philoprogenitiveness	14 Reverence	26 Coloring	
4 Adhesiveness	15 Firmness	27 Locality	
5 Inhabitiveness	16 Conscientiousness	28 Order	
6 Combativeness	17 Hope	29 Calculation	
7 Secretiveness	18 Marvelousness	30 Eventuality	
8 Acquisitiveness	19 Ideality	31 Time	
9 Constructiveness	20 Mirthfulness	32 Tune	
	21 Imitation	33 Language	

FIGURE 4.10 *A phrenologist's map. From Boring, 1950.*

In the visual system stimuli in the left visual field are represented on the right hemisphere, and stimuli in the right field on the left. Furthermore, arrangements within the visual area of each hemisphere insure that stimuli which are near to each other "in the world" will stimulate points which

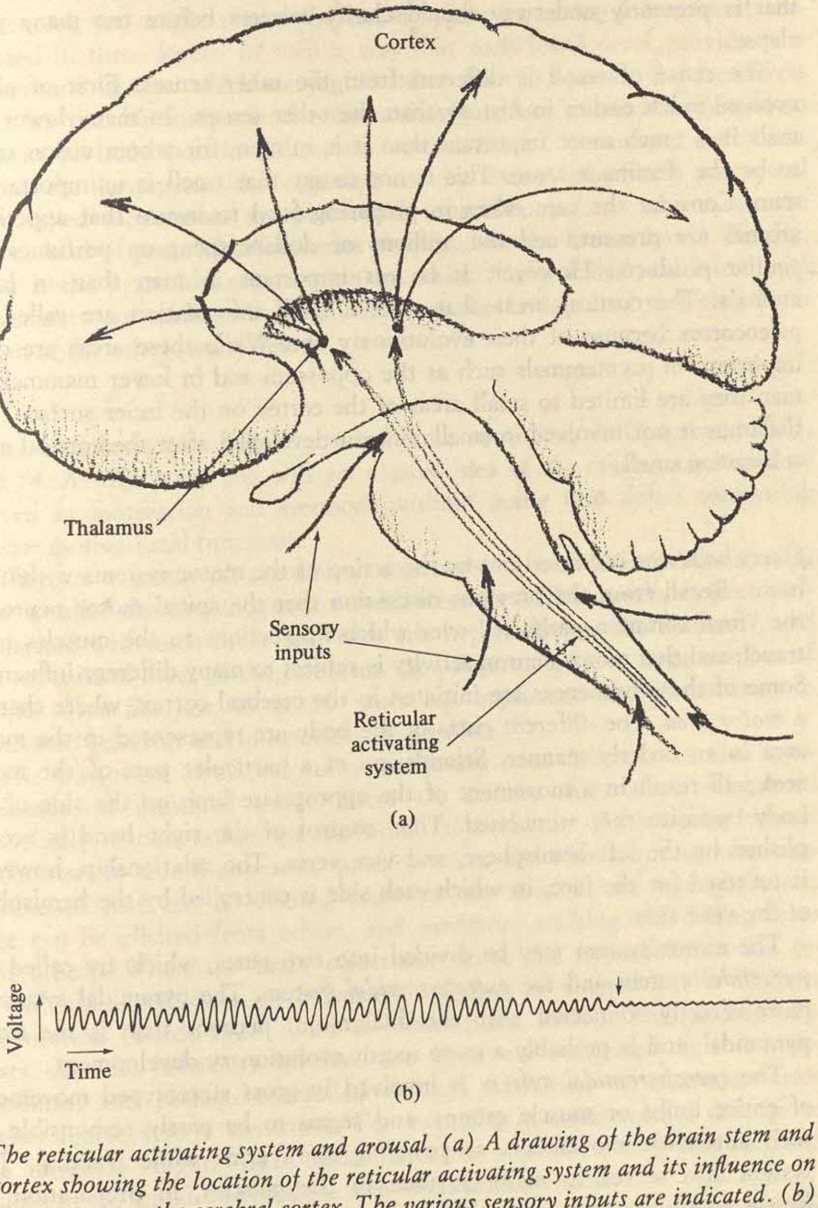


FIGURE 4.11

The reticular activating system and arousal. (a) A drawing of the brain stem and cortex showing the location of the reticular activating system and its influence on the cerebral cortex. The various sensory inputs are indicated. (b) Electroencephalographic tracing of the effect of stimulating the RAS on a monkey. To the left of the arrow, the high-voltage slow activity indicates that the monkey is asleep. At the arrow it is stimulated in the reticular system, and the activity shifts to the low-voltage fast activity typical of waking (French, 1957).

are adjacent to each other in the cortex. Exactly what role these cortical "maps" play in perception is not well understood at present. In the case of somesthesis, the map rather clearly reflects the cortical areas responsible for tactile sensations from the various limbs and other parts of the body. The situation is not so clear in the case of vision and hearing, but research that is presently underway should clarify matters before too many years elapse.

The sense of smell is different from the other senses. First of all, it evolved much earlier in history than the other senses. In many lower animals it is much more important than it is in man, for whom vision seems to be the dominant sense. This is not to say that smell is unimportant in man. Consider the care taken in preparing food to insure that appetizing aromas are present, and the millions of dollars spent on perfumes and similar products. However, it is less important in man than in lower animals. The cortical areas that receive smell information are called the paleocortex because of their evolutionary age. While these areas are quite important in premammals such as the oppossum and in lower mammals, in man they are limited to small areas of the cortex on the inner surface. The thalamus is not involved in smell, since it developed after the cortical areas subserving smell.

Motor Systems

Overt behavior is carried out by the action of the motor systems within the brain. Recall from the previous discussion that the spinal motor neuron is the "final common pathway" over which instructions to the muscles must travel, and that motor neuron activity is subject to many different influences. Some of these influences are initiated in the cerebral cortex, where there is a *motor area.* The different parts of the body are represented in the motor area in an orderly manner. Stimulation of a particular part of the motor area will result in a movement of the appropriate limb on the side of the body opposite that stimulated. Thus control of the right hand is accomplished by the left hemisphere, and vice versa. The relationship, however, is reversed for the face, in which each side is controlled by the hemisphere of the same side.

The motor system may be divided into two parts, which are called the *pyramidal* system and the *extrapyramidal* system. The pyramidal system is more directly connected with the final motor neurons than is the extrapyramidal, and is probably a more recent evolutionary development.

The *extrapyramidal system* is involved in gross stereotyped movements of entire limbs or muscle groups, and seems to be partly responsible for such automatic movements as swinging one's arms while walking. This system also serves to maintain tone in the muscles, in preparation for future activities. Patients with certain kinds of damage to the extrapyramidal system show various automatic kinds of movements such as writhing of the arm, and "pill rolling" movements of the hand and fingers. Another type of extrapyramidal disorder is Parkinson's disease, which results in muscle rigidity coupled with tremors.

The *pyramidal system* is responsible for voluntary movements of a skilled nature, in which the selection of a particular muscle or muscle group is required. The destruction of the pyramidal system renders a patient unable to carry out such selective movements.

ORGANIZATION

In general, you might regard the motor systems as being hierarchically organized in three levels, in such a way that each lower level provides the background against which the higher influences can operate. At the lowest level are the various postural reflexes that keep one's muscles adjusted to changes in body position, direction and extent of movement, etc. Next comes the extrapyramidal organization, by means of which gross and stereotyped movements are performed (superimposed, of course, on the background of postural adjustments organized by the lowest level). Finally, there is the pyramidal organization by which finely skilled and intentional movements are made, superimposed upon the background resulting from action of the other two systems.

Motivation and Emotion

These complex topics will be covered more adequately in Chapters 12, 13, and 14. At this point you will get a gross idea of the neural structures involved in motivation and emotion, without going into detail concerning precise motivational functions.

There is a group of anatomical structures surrounding the brain stem that is called the *limbic system* (limbic=border). The structures are interconnected with each other and with the hypothalamus, the thalamus, and the neocortical areas of the cerebrum (see Figure 4.12). A large number of studies over the last 45 or 50 years has implicated these structures in motivated behavior and in emotional expression.

The way these structures seem to operate is as follows: In the hypothalamus, as indicated above, there are centers that, when stimulated electrically, evoke rather specific kinds of behavior which under normal circumstances would appear to be motivated. For example, responses suggestive of fear can be elicited from certain sites in the hypothalamus; rage can be elicited from others, and predatory stalking and killing from still others. When the brain structures above the hypothalamus are removed, these responses are enhanced, and may be elicited at the slightest provocation (Bard, 1928; Bard & Mountcastle, 1948). This finding suggests that the behaviors involved are somehow integrated in the hypothalamus, and perhaps controlled through inhibition or excitation from higher limbic system structures. For example, in some studies damage to the amygdala (Figure 4.12) makes it easier to evoke a rage reaction, and lesions in the septal area produce somewhat similar effects.

Other research has found that electrical stimulation in certain of the limbic system areas is apparently rewarding, in that animals will work very hard in order to receive such stimulation (Figure 4.13). Other areas seem to produce the opposite effects, in that stimulation of them will support the learning of avoidance habits. We may assume that whatever it is about

rewards that causes them to support new learning is somehow represented in these "pleasure centers" of the brain; likewise, the effect of punishment somehow is tied in with action in the aversive centers.

Cognition and Thinking

There is no question but that the brain is the organ with which we do our thinking. Thinking, however, is a very complex activity and is not very well understood. Furthermore, we do not know very much about how it is accomplished by the brain. On the other hand, certain aspects of the thinking process can be dealt with, at least more or less in isolation from

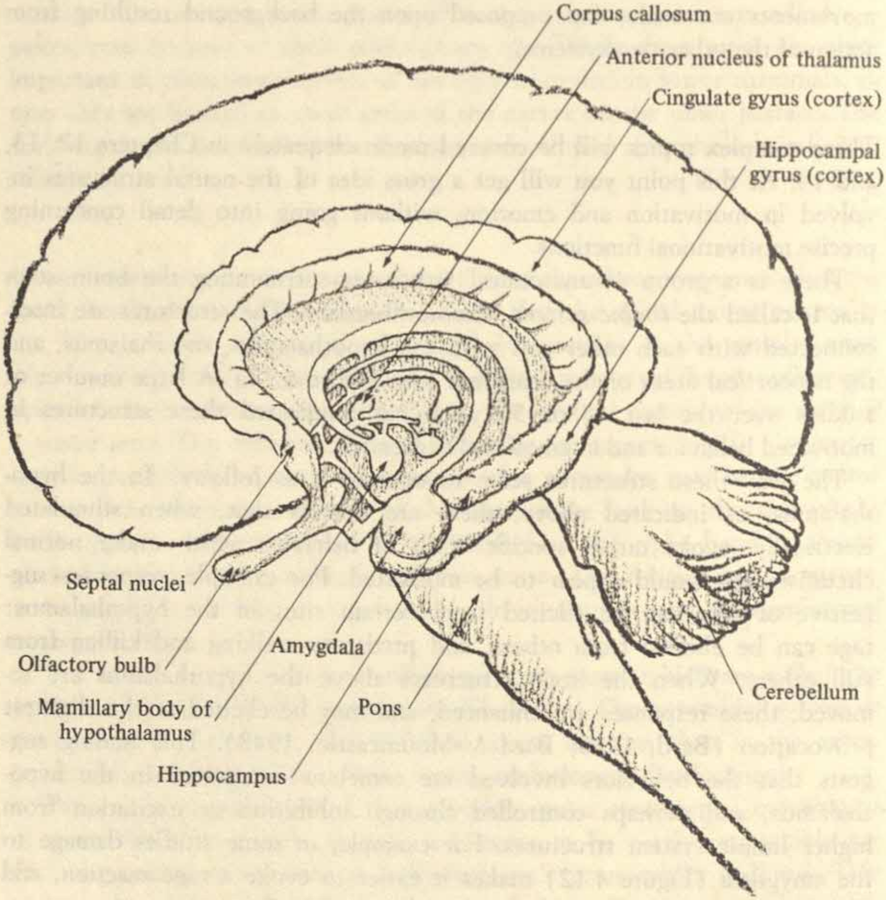


FIGURE 4.12 *The main structures in the limbic system. The main nuclear areas are stippled, and the pathways connecting them are solid. The olfactory bulb is also included, since it is anatomically a part of this system. The hippocampus, hippocampal gyrus, and amygdala are actually located within the temporal lobe. The septum, mamillary bodies, and other nuclei are located closer to the midline. The cingulate gyrus can be seen on the medial surface of the cerebral cortex (Figure 4.9). From MacLean, 1949.*

one another, and these aspects can be related in a gross way to brain processes. (See p. 106).

IMAGERY

In some people thinking involves the use of imagery—i.e., the internal production and manipulation of symbolic processes that have a perceptual character. One can imagine what a friend looks like, and the experience may be quite a vivid one, in which the various features of the friend's face are experienced in the same way that one would experience them if the friend were present. Not every one images in this way, but for those who do, imagery constitutes a significant aspect of thinking. Recent work with human patients has suggested that the right cerebral hemisphere is particularly important in imagery, particularly visual imagery. Portions of the right temporal lobe seem especially to be involved in the solution of visual problems that require an appreciation of incongruities in pictures, e.g., recognizing the inappropriateness of, say, a bird in a fish bowl (Milner, 1958).

LANGUAGE

Thinking also involves the use of language processes. In fact, for many people thinking is mostly verbal and, of course, highly dependent upon language ability. What this means is that when one thinks, he manipulates symbols—words—by means of which the most abstract logical operations may be performed. Language, it seems, is primarily dependent upon the

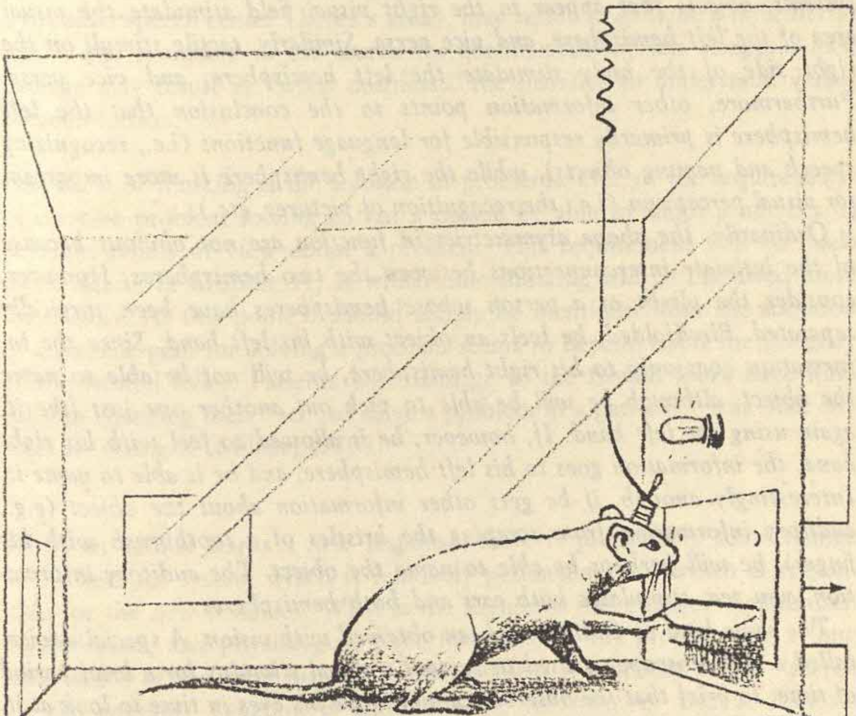


FIGURE 4.13

Self-stimulation. The rat has been operated on and a tiny electrode implanted into its brain. When the lever is pressed, a brief electric current is delivered to the brain through the electrode.

Human Beings with Separated Left and Right Cerebral Hemispheres

What do you suppose it would be like to be two different people at once? While it sounds rather far-fetched, there are indications that some human neurological patients may have something like that kind of experience. These patients have been subjected to a rather drastic operation whose purpose is to alleviate the symptoms of epilepsy. The operation involves cutting the nerve fibers connecting the left and right cerebral hemispheres. It has proved to be successful in reducing the epileptic symptoms in many patients, and it seems to have few serious side effects from the psychological point of view. At least the patients are not obviously impaired in any way.

On the other hand, it seems strange that interrupting the communications that ordinarily go back and forth between the two hemispheres would have so little effect, and, indeed, careful observations by researchers have revealed some very interesting symptoms. Analysis of these symptoms has shed some light on the way the two halves of the brain work.

Because of the anatomical arrangement of the visual and somatic sensory systems, objects that appear in the right visual field stimulate the visual area of the left hemisphere, and vice versa. Similarly, tactile stimuli on the right side of the body stimulate the left hemisphere, and vice versa. Furthermore, other information points to the conclusion that the left hemisphere is primarily responsible for language functions (i.e., recognizing speech and naming objects), while the right hemisphere is more important for visual perception (i.e., the recognition of pictures, etc.).

Ordinarily, the above asymmetries in function are not obvious because of the intimate interconnections between the two hemispheres. However, consider the plight of a person whose hemispheres have been surgically separated. Blindfolded, he feels an object with his left hand. Since the information goes only to his right hemisphere, he will not be able to name the object, although he will be able to pick out another one just like it, again using the left hand. If, however, he is allowed to feel with his right hand, the information goes to his left hemisphere, and he is able to name it. Interestingly enough, if he gets other information about the object (e.g., auditory information from scraping the bristles of a toothbrush with his finger), he will perhaps be able to name the object. The auditory information, you see, stimulates both ears and both hemispheres.

The same kind of finding has been obtained with vision. A special device, called a tachistoscope, is used to present a visual stimulus for a brief period of time, so brief that the observer cannot move his eyes in time to look at it. Usually, 0.20 second is fast enough. If a word is presented to his right visual field (i.e., to the right of the point at which he is looking), the information will reach his left hemisphere, and he will be able to read the word. How-

ever, if the word is presented to his left visual field, he will not be able to read it, since the information goes to his right hemisphere. He will, however, be able to recognize a picture presented to his right hemisphere (i.e., in his left visual field).

Some rather interesting conflicts have been noted. If two different pictures are presented simultaneously, one to the left hemisphere and the other to the right hemisphere, he will perceive them both. However, if asked to describe what he saw verbally, he will describe only the right field (left hemisphere) picture. If asked to recognize the picture, i.e., to point to one of several examples which was like the one he saw, he will point to the one that was presented to his right hemisphere (i.e., the one in the left visual field). In other words, he will see two different objects at once but be unaware of that fact.

A pornographic picture presented to the right hemisphere will cause him to blush, but he will be unable to describe the picture or say why he is blushing. Thus the meaning of visual stimuli is not restricted to verbal meaning, but apparently can exist independently of verbal meaning (Sperry, 1964; Gazzaniga, 1967).

left cerebral hemisphere. Damage to the left frontal lobe, which contains a so-called speech center (Broca's area), may result in *aphasia,* a difficulty in which one is unable to use words for communication; left temporal lobe damage may result in "word deafness," the inability to understand verbal communication.

FLEXIBILITY

One form of thinking is the solution of problems. One of the requirements of creative problem solving is that a person be able to adopt a number of different points of view about a problem. This requirement will be made much clearer in Chapter 11, at which time thinking will be discussed more thoroughly. At this point it should simply be mentioned that the adoption of a flexible plan for solving a problem seems to depend upon the integrity of the frontal lobes. Patients with damage to the frontal lobes have difficulty in changing their "set" to solve a problem in a particular way once the rules are changed (Milner, 1970).

Learning and Memory

When an animal learns a new response, there is presumably some change in the nervous system which is relatively permanent, and which is responsible for the new behavior. What is the nature of this change? Anatomists, psychologists, and physiologists have investigated this problem for a long time. Much of the early history of this problem is a history of the "search for the engram" (engram is another name for memory trace). Animals were trained in particular tasks, such as a visual discrimination problem, in which, say, selecting a triangle resulted in reward, selecting a circle did not. Then various portions of the brain were removed and the animal was re-

tested. The results of many, many such experiments have indicated that the trace is not localized in any particular portion of the brain. Basically, damage to only small areas of brain will not result in any appreciable deficit in performance unless the damage is to a primary sensory area, in which case, of course, the sensory information may be partly blocked.

More recent work has been of a biochemical nature. The idea is that memory involves some chemical change in the nervous system, probably a change in the structure of some complex protein moelcules within the cells, so that patterns of synaptic transmission are altered. It has been found, for example, that injections of puromycin, an antibiotic that inhibits protein synthesis, into the brain immediately after a learning experience will prevent the memory of that experience in various animals, including mice (Flexner, Flexner, & Roberts, 1967) and goldfish (Agranoff and Klinge, 1964). The specific nature of the protein changes involved in memory is not known at the moment, nor is it clear how widely distributed in the brain the changes would be. Researchers are quite active in this area at present, and we may expect some more definitive answers in the future.

A WORD OF CAUTION

The above treatment is quite sparse, brief, and oversimplified relative to the intricacies of the research in brain functions. Much too much space would be required to give a reasonably accurate account of the most recent findings, which are often contradictory and require special interpretation. For example, the approach has been to discuss "centers" that perform certain "functions." These functions are presumably lost when the center is removed. However, this is perhaps not the best interpretation. There is much evidence that whenever a "center" is lost, the brain undergoes a certain amount of *reorganization.* In other words, the remaining centers function differently because of the damage. Consequently, the effects of a given lesion may change over time as the brain tissue reorganizes itself. Behavioral capacities that showed transient losses may recover after a time, and other deficits may appear. For instance, the enhanced rage response in animals with lesions in the amygdala develops over several months' time.

The effects of brain stimulation are also equivocal. Does an electrical stimulus excite the tissue to which it is applied, or does it inhibit its normal functioning? It may do one thing under certain circumstances, and the other under other circumstances. Penfield's stimulation studies (p. 97), for example, showed that stimulation of the speech area would *interfere* with such behaviors as naming objects, while stimulation of other areas would *produce* complex memories, which are reexperienced rather vividly. Do the memories "reside" in the area stimulated or does inhibition of that area *release* some other area to produce the experiences?

Understanding how the brain functions in behavior and experience is a very difficult undertaking. Eventually, the difficulties in interpretation will be ironed out. You need to be aware, however, at least in general terms, of how the problems are approached and what some of the general, although temporary, conclusions are.

Summary

The basic anatomical elements of concern to neuropsychology are receptors, neurons, muscles, and glands. Receptors are sensitive to energies in the environment and chemical changes within the organism. The information that they sense is transmitted via neurons to the brain, which itself is composed of neurons. Behavior comes about when the brain sends messages to muscles and glands. The neural message is the action potential, which is an electrochemical change propagated along the neuron. The point at which one neuron influences another is the synapse, where a chemical mediates the transfer of information. The synapse is also the point at which the integration of information from various sources takes place.

The simplest form of integrated activity is the reflex, by means of which a stimulus automatically evokes a specific response. The reflex also, however, provides feedback, which is the means whereby the consequences of a given action can affect the likelihood of that action's occurring again.

The brain can be subdivided in a number of ways. The central and peripheral nervous systems constitute one subdivision. Nuclei and ganglia, where most synapses occur, and nerves and fiber tracts, which carry messages to the synapses, are another basic division.

A third type of subdivision is into somatic (serving movements of the body and the senses) and autonomic (self-regulating). The autonomic nervous system consists of sympathetic and parasympathetic branches. The sympathetic branch is active in emotional responses and adapts one to fight or flight. The parasympathetic is more concerned with negative functions.

A fourth subdivision is into the forebrain, midbrain, and hindbrain. The forebrain contains the cerebral hemispheres, which are thought to be responsible for most of the human perceptual and intellectual functions.

The nervous system may also be divided into functional systems, including those serving the senses and perception; motor systems; and systems responsible for motivation and emotion, for cognition and thinking, and for learning and memory. These functions are not completely worked out at the moment, and many anatomical areas seem to overlap in their functions. However, there is support for the idea that different parts of the brain have different roles in determining the organism's behavior.

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Sensing Information in the Environment

5

The environment contains information, and it is biologically essential that organisms, including human beings, be able to to respond to it. *External* information for animals includes surfaces on which to travel or spaces within which to swim, obstacles to avoid, food to eat, odors to approach or avoid, objects to manipulate as tools, etc. The *internal* environment also contains information about such things as the temperature of the body, nutritional state, abnormalities producing pain, etc.; response to this information is also essential for survival.

Patterns of energy impinging on and within the body surface carry the environmental information, in that these patterns specify relevant objects and events. The energy consists of light; mechanical events such as sounds, the pull of gravity, body movements, and objects one contacts; heat; and chemical energy, including tastes and smells. Organisms contain receptors capable of transducing this energy (Chapter 4), and sense organs and perceptual systems capable of responding to patterns of distribution of the energy.

In this chapter we shall consider some of the basic processes involved in the response to light, mechanical stimulation, heat, and chemical stimulation. Pain, which is a response to extremes of all forms of energy, will be discussed separately. In many cases you will see how patterns of distribution of the energies specify objects that are relevant to the animal, and how the receptors and sense organs deal with these patterns.

Light

Visible light consists of a narrow band of the electromagnetic spectrum (Figure 5.1), most of which we cannot see or in any other way experience

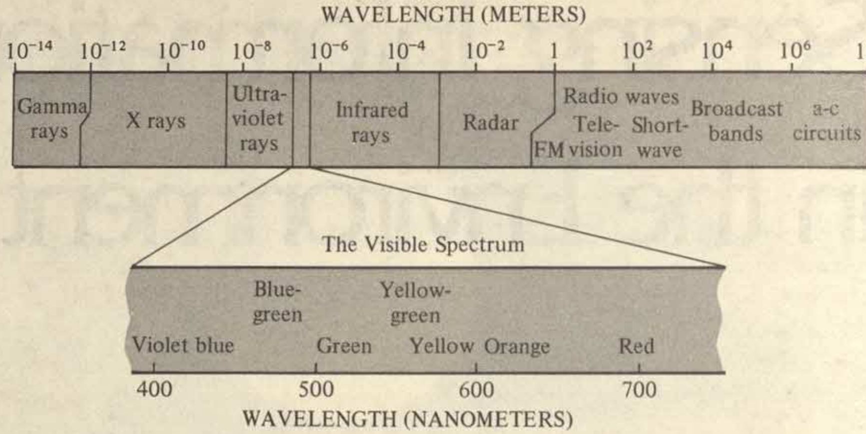


FIGURE 5.1 *The electromagnetic spectrum. Note that wavelengths range from 10^{-14} (.00000000000001) to 10^{8} (100,000,000) meters in length and that only a very narrow portion of that spectrum is seen. The visible portion of the spectrum is shown expanded below.*
From Chapanis, Garner, & Morgan, 1949.

directly. Light radiates from its source, such as the sun or a light bulb, into the atmosphere which contains water vapor, dust particles, smog, etc., which modify the light in various ways. They may *absorb* some of the light, thereby reducing the amount reaching your eye; they may bend, or *refract,* the rays, thereby changing its direction of travel; they may *reflect* some of the light, which also changes its direction of travel. Quite often the changes in direction are quite haphazard, and the net effect is *diffusion,* which "softens" the light. The same processes occur when the light encounters objects: it is absorbed, reflected, refracted, and often diffused. Thus the light radiating from the light bulb in the ceiling of your room is partially absorbed, and multiply reflected and refracted before reaching your eye.

Since different objects will modify the light in different ways, the light reaching your eye will depend in some way on the objects it has encountered. In other words, the pattern of light at your eye can be said to *specify the object.* Some of the modifications of the light account for our perception of the *layout of the environment,* including the orientation of surfaces, location of objects, and certain of their properties such as shape and texture. Other modifications account for our perception of the *color* of an object.

The Optic Array

For a given point in space, there are light rays arriving at it from all directions, and their structure specifies objects in the environment. If someone happens to be located at that point in space, then the light rays entering his eye contain *potential information* about the environment. (It is called potential information because not every animal can respond to all aspects of it, and *actual* information requires a responding animal.) J. J. Gibson

(1950, 1966) has suggested that the light reaching an eye at a given point in space be called the *optic array.* Potential information about the environment, then, is contained in the optic array.

You may visualize the optic array by imagining yourself painting a picture of the world on a plate glass window, with your head remaining still. The resulting picture will be representative of the pattern of light rays projected onto your retina, although the actual pattern on the retina is reversed and inverted from that on the window, because of the optical effect of the cornea and lens in the eye. Several properties of the optic array and the layouts that they specify are indicated in Figure 5.2. Note that *surfaces* are specified by gradients, or gradual changes, of texture in the optic array, while *edges* are specified by *abrupt changes* in the texture gradient. The *surface properties* of objects, such as texture, etc., are specified by the unique pattern making up the texture gradient.

If you move your head to the left or the right, you will sample different optic arrays, and the transformation from one to the next will be quite regular (Figure 5.3). Note what would happen if you drew two pictures on your window, one from a slightly different point of view than the other. The representation of objects in the foreground will move in the direction opposite your head movement, while the projection of objects at a distance will move in the same direction as your head movement. This phenomenon is called *motion parallax, or relative motion,* and is quite important in perceiving the relative distances of objects.

If an object is *approaching* you on a collision course, its direction of movement is also specified by a regular change in the optic array—its representation will expand symmetrically. Expansion of an optic array is a potent stimulus for avoidance behavior in many animals, including human infants.

In summary, then, many of the physical properties of objects are specified by variations in the texture of the optic array. Additional properties are specified by regular transformations, which occur as different arrays are sampled or as objects move within a given array. The potential information is there in the bundle of light rays. An animal, however, may or may not be able to use this information, depending upon whether its visual system can extract it effectively. If the information can be extracted and processed, then it becomes actual information.

STEREOPSIS: TWO ARRAYS AT ONCE

Because we have two eyes, we can sample two different optic arrays at once. Since no two arrays are alike, the brain must combine the information from the two eyes to yield a single impression of the environment. The difference, or *disparity* between the two arrays and their combination into a single impression is the basis for *stereopsis,* or *stereoscopic vision.* Stereopsis results in the experience of depth, or solidity, of objects and is the basis for the three-dimensional experience one has when viewing stereoscopic slides in a slide viewer. The two slides seen in the viewer are made from slightly different points in space (i.e., they register information from two different optic arrays), and the two disparate views are fused into one three-dimensional view [see Figure 5.4(a)].

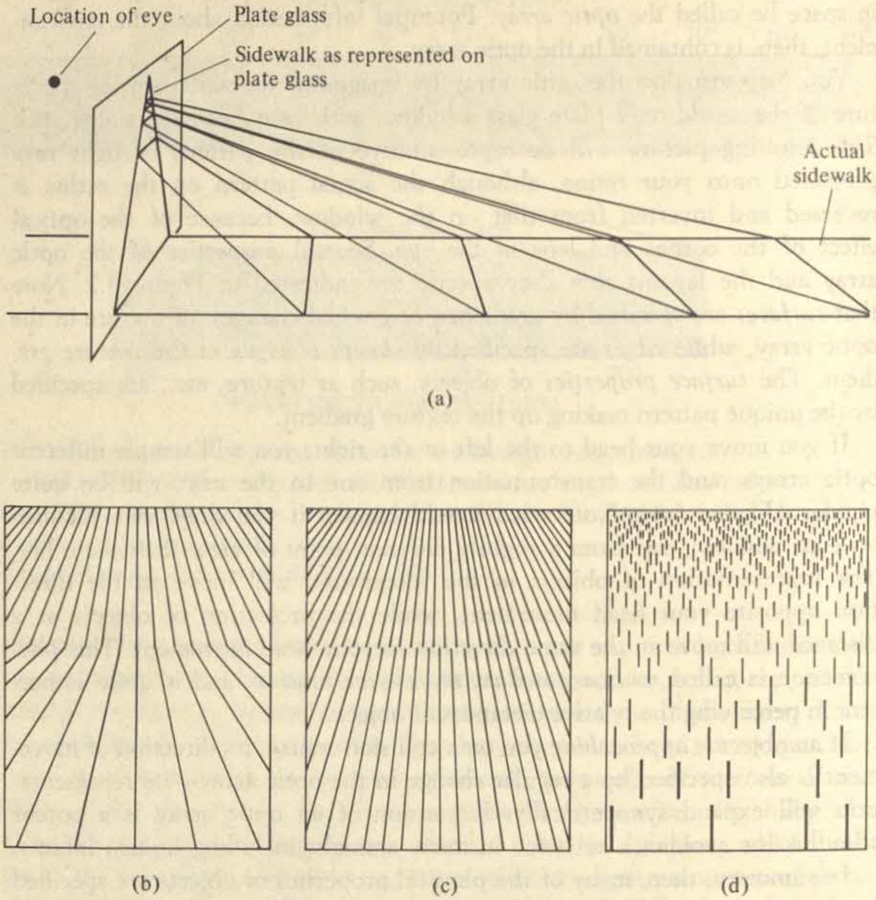
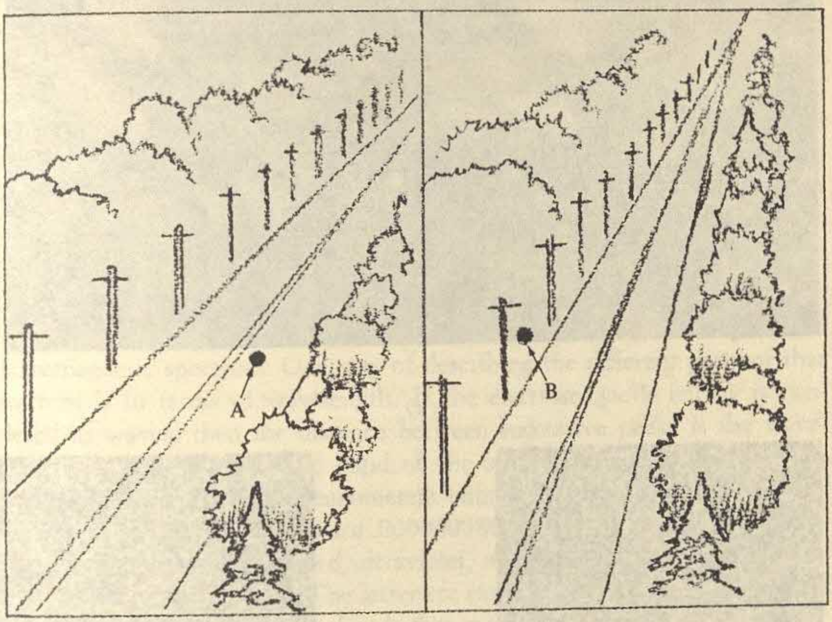
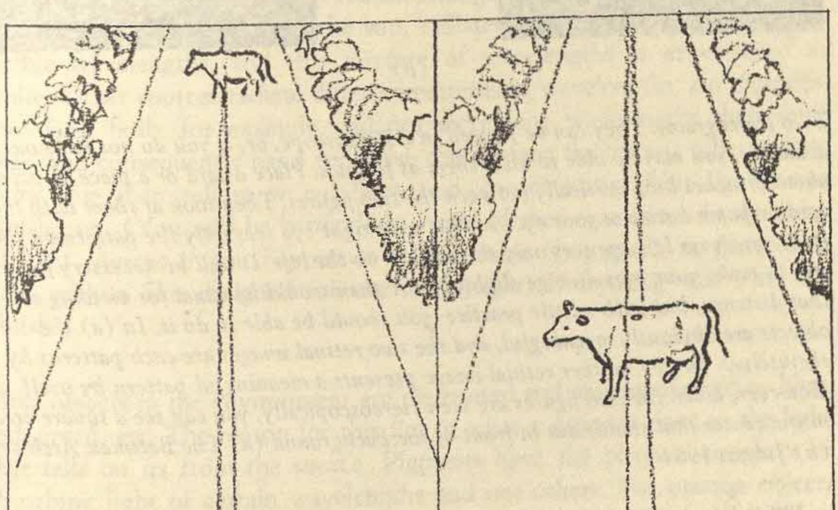


FIGURE 5.2 *The optic array: representation of the world on a plate glass. (a) How a sidewalk would be projected onto a plate glass, as described in the text. (b) Representation of a sharp corner in the optic array. Note the abrupt change in the gradient of width of the elements at the location of the corner. (c) A "cliff," as represented in the optic array. Note that the density of the elements changes abruptly, although the gradient itself does not change (i.e., the lines are all converging to the same point at the top of the illustration). (d) A surface in which the elements are discrete units of texture, rather than converging lines.*
From Gibson, 1950.

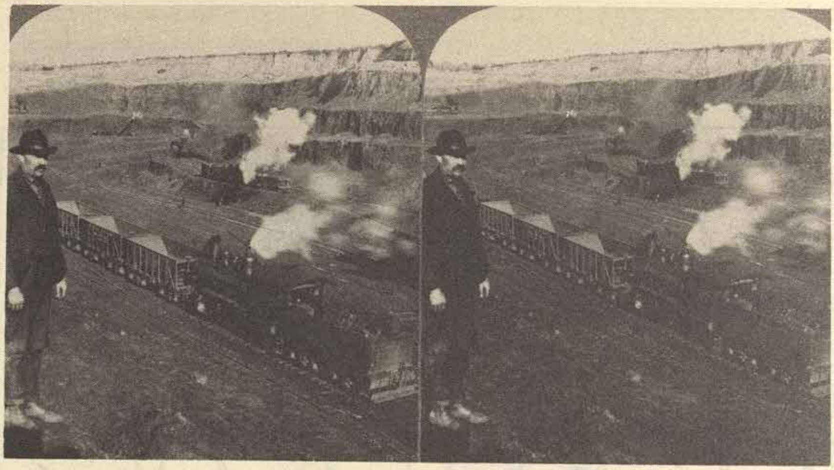
FIGURE 5.3 *Transformations in the optic array resulting from movement. (a) Motion parallax, resulting from sidewise motion of the head. Using the plate glass analogy described in the text: Moving the head from point "A" in the left-hand panel to point "B" in the right-hand panel will result in the change shown. Note that the foreground moves to the right, i.e., in the direction opposite the head movement, while the upper ground moves to the left, in the same direction. (b) Looming, which occurs when you are on a collision path with an object. The cow in the road which you are approaching while driving and drawing on your plate glass window at the same time becomes larger as you approach it.*



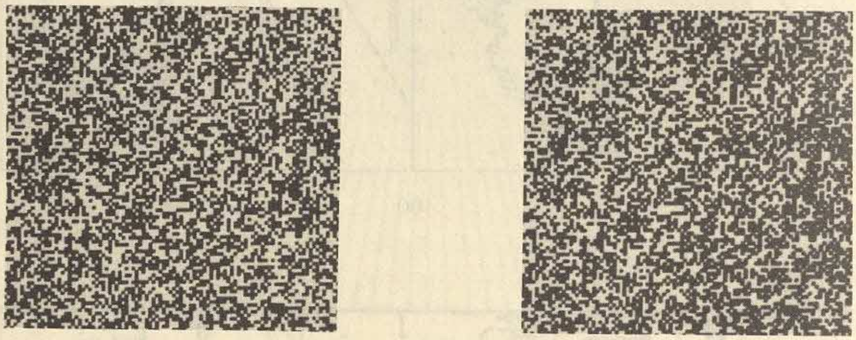
(a)



(b)



(a)



(b)

FIGURE 5.4 *Two stereograms. They can be viewed in a stereoscope, or, if you do not have one available, you may be able to view them as follows. Place a card or a piece of paper about 8 inches long vertically between the two figures. Then look at them with the card or paper between your eyes so that your right eye sees only the pattern on the right, and your left eye sees only the pattern on the left. It will be necessary for you to make your eyes diverge slightly more than would be usual for viewing at that distance, but with a little practice, you should be able to do it. In (a) the objects are obviously meaningful, and the two retinal images are each patterns by themselves. In (b) neither retinal image presents a meaningful pattern by itself. However, when the two figures are seen stereoscopically, you can see a square area in the center that stands out in front of the background (a) The Bettman Archive; (b) Julesz, 1964.*

While the stereoscopic depth experience ordinarily comes from the fusion of two different optic arrays, both of which contain information, it is not *necessary* that both arrays contain information. Consider the pair of pictures in Figure 5.4 (b). Each one is a meaningless pattern of random dots. However, when the two patterns are viewed in a stereoscope, one can, with practice, see a square in the middle of the fused pattern that stands out in

front of a background. The reason is that the dots within a square area in one of the figures have been shifted slightly to the right, relative to the rest of the dots. Otherwise, the two figures are identical. (You may be able to see the phenomenon yourself if you can obtain a stereoscope. Otherwise, you may be able to see it by placing a card vertically on the page between the two figures so that your right eye sees the right figure, your left eye the left one. Then try to adjust your eyes so that you see only one fused image.)

This phenomenon means that not only is information carried by two independent optic arrays, but it is also carried by the *relationship* between the two, such that no information other than that contained in the relationship is necessary for you to perceive a meaningful pattern.

Color

It was mentioned earlier that visible light consists of a narrow band of the electromagnetic spectrum. One way of describing the different parts of that spectrum is in terms of wavelength. If the electromagnetic energy is considered as waves, then the distance between successive peaks is the wavelength (see Figure 5.1). The band of the spectrum that we can see lies between about 380 and 760 nanometers (nm). (There are 10^9 nanometers in 1 meter, so 380 nanometers are .000000380 meter.) Wavelengths shorter than 380 nanometers are called ultraviolet, and those longer than 760 nanometers are called infrared. The latter are experienced as heat. (The reason an incandescent light bulb gets hot is that most of the energy radiated by it is in the invisible infrared region of the spectrum.) Within the visible spectrum, the different wavelengths are experienced as different colors ranging from violet at the short end to reddish orange at the long end (Figure 5.1).

When a light source, e.g., the sun, radiates energy, it radiates all of the visible wavelengths, and this mixture of wavelengths is experienced as white. Other sources radiate different patterns of wavelengths. An incandescent light bulb, for example, radiates more long wavelengths than short ones, and consequently has a yellowish color. Many fluorescent tubes radiate more blue than yellow or red light, and, consequently, their light has a bluish cast. (You will be particularly aware of these variations in the color of light sources if you happen to take a color photograph in fluorescent light with a film designed for use in daylight. Everything will turn out bluish.)

PIGMENTS

Most objects in the environment are pigmented and are experienced as blue, red, green, etc. The reason for this lies in what a pigment does to the light that falls on its from the source. Pigments have the physical property of absorbing light of certain wavelengths and not others. For opaque objects the light that is not absorbed is reflected; it is the reflected light that makes its way to the optic array described earlier. (Some objects are translucent, and the light arriving at an optic array from that object may be determined both by reflection and by transmission through the object. However, the principle is the same. The light in the optic array is whatever is left after

the object and the atmosphere have absorbed whatever they are going to absorb.)

Since the properties of the object are specified by the properties of the optic array, object color is determined by the pattern of wavelengths composing the optic array. Once again, it should be pointed out that the information in the optic array is potential information only. It becomes actual information only if an animal's perceptual system is capable of registering it in some way. This fact is especially obvious in the case of wavelength. Some animals, including most primates, many birds, reptiles, and invertebrates have perceptual systems capable of registering wavelength information. Other animals, including one nocturnal monkey, rats, and a number of other animals, are color-blind, i.e., they do not register the wavelength information, or at least not very well. Color vision, the extraction of wavelength information, will be discussed in the next section.

Extraction of Information from the Optic Array

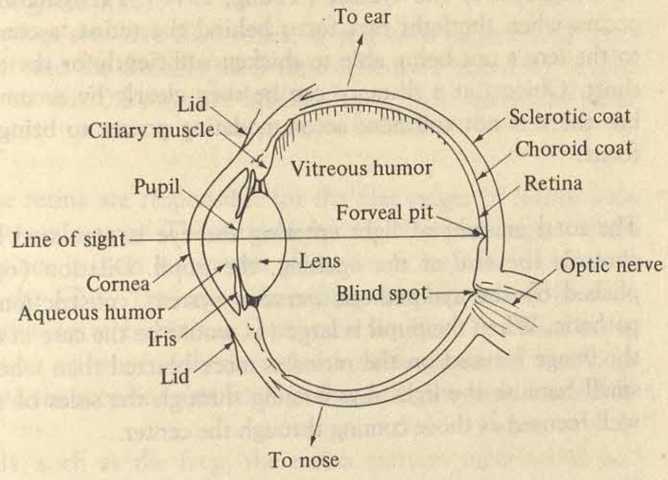
The process of extracting information from the optic array is quite involved, and not completely understood. The first stages of extraction occur in the *retina,* the complex organ at the back of the eye that contains the receptors for light and several types of neurons, including those which make up the optic nerve. The optic nerve passes the information to higher centers in the thalamus and the midbrain, where additional processing takes place. It is then passed (especially from the thalamus) to the cerebral cortex, where further processing takes place. The details of the processing seem to be different in different animals, although it appears that the visual systems of most mammals are organized on basically the same principles.

FOCUSING AND ACUITY

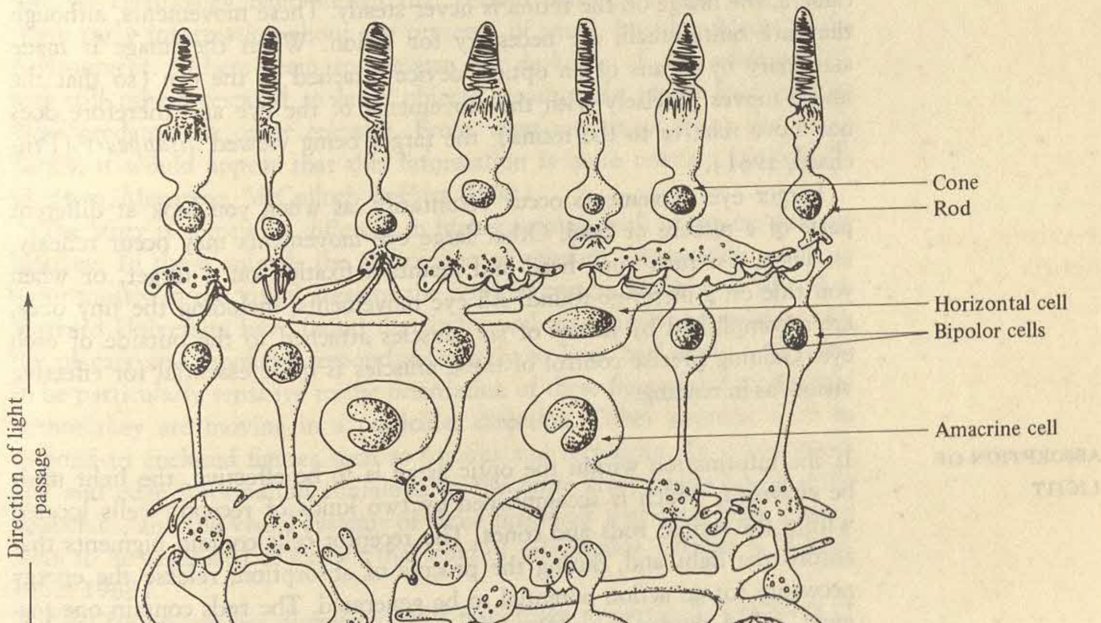
The optic array must first be focused on the retina (Figure 5.5), which is accomplished by the *cornea* and the *lens.* The cornea refracts the light a fixed amount, but the lens is variable so that targets at different distances may be sharply focused through changes in its shape. These changes are called *accommodation* and are caused by the action of the *ciliary muscle* within the eyeball, which is under control of the parasympathetic nervous system. For the clear vision of near objects the lens must become thicker; for far objects it must become flatter.

The net result of the focusing of the light rays on the retina is *acuity,* which may be good or poor, depending on how well the rays are focused. In *myopia,* or nearsightedness, the light rays are focused in front of the retina, either because of excessive activity of the ciliary muscle, a condition

FIGURE 5.5 *The anatomy of the eye. In (a) is shown a section through a right eye. The section is horizontal, as though the knife making it cut parallel to the ground. (b) A diagram of a section through the retina, much enlarged. Note the different shapes of the rods and the cones. The horizontal cells and the amacrine cells connect adjacent areas of the retina with each other, while the bipolar cells and ganglion cells pass the information in the direction of the brain. Note that the axons of the ganglion cells make up the optic nerve.*
(a) From Judd, 1952, (b) from Dowling and Boycott, 1966.


To ear
Lid
Ciliary muscle
Pupil
Line of sight
Cornea
Aqueous humor
Iris
Lid
Vitreous humor
Lens
Forveal pit
Blind spot
Sclerotic coat
Choroid coat
Retina
Optic nerve
To nose

(a)


Direction of light passage
Cone
Rod
Horizontal cell
Bipolor cells
Amacrine cell
Ganglion cells
Optic nerve fibers

(b)

that is sometimes made worse by excessive amounts of "near work," or by elongation of the eyeball (Young, 1970). Farsightedness, or *hyperopia,* occurs when the light rays focus behind the retina, a condition usually due to the lens's not being able to thicken sufficiently or the eyeballs' being too short. Objects at a distance can be seen clearly by accommodating slightly, but there is not sufficient accommodating power to bring near objects into focus.

LIGHT REGULATION

The total amount of light entering the eye is regulated by the *iris,* which controls the size of the opening, the pupil. Dilation (opening) is accomplished by the sympathetic nervous system, constriction by the parasympathetic. When the pupil is large (as would be the case in dim illumination), the image focused on the retina is more blurred than when it is moderately small because the light rays coming through the sides of the lens are not as well focused as those coming through the center.

EYE MOVEMENTS

The eyeballs are continually in motion, even when you think you are staring at something (i.e., fixating). Thus, unlike the image on the film of a camera, the image on the retina is never steady. These movements, although they are quite small, are necessary for vision. When the image is made stationary by means of an optical device attached to the eye (so that the image moves precisely with the movements of the eye and therefore does not move relative to the retina), the target being viewed *disappears* (Pritchard, 1961).

Larger eye movements occur voluntarily, as when you look at different parts of a picture or read. Other large eye movements may occur reflexly, as when you turn your head and maintain fixation on a target, or when you ride on a merry-go-round. All eye movements, including the tiny ones, are accomplished by means of six muscles attached to the outside of each eye. Gaining precise control of these muscles is quite essential for effective vision, as in reading.

ABSORPTION OF LIGHT

If the information within the optic array is to be effective, the light must be *absorbed*, which is accomplished by two kinds of receptor cells located within the retina: rods and cones. The receptor cells contain pigments that absorb the light and, during the process of absorption, release the energy necessary for an action potential to be generated. The rods contain one pigment, called rhodopsin, while there are three different kinds of cones, each containing a different pigment. The rods are used at night, while the cones are used during the day and, as you will see presently, are responsible for color vision.

The brightness of various colors depends upon the relative amount of light of a particular color that is absorbed by the pigment. Since rhodopsin, which is used at night, does not absorb red light as well as green light, objects that in daytime would appear bright red will at night appear darker than green objects. (Since the rods are color-blind, both objects would

actually appear gray at night; however, the red object will appear to be a darker gray than the green one.)

Rods are much more sensitive than cones, as you have experienced when going from daylight into the dark. It takes time (about 45 minutes) to completely dark-adapt so that the rods are functioning at their maximum sensitivity.

EXTRACTION OF PATTERN INFORMATION

The neurons in the retina are responsible for the first stages of information extraction from the optic array. The retina is quite a complex organ, which is to be expected since it is an outgrowth of the brain and, therefore, technically a part of the CNS. The story describing how information is extracted is only beginning to be written, but some headway has been made. A precise description of what is known about these processes would go considerably beyond the scope of this book so that here we provide only the broad outline.

In some animals, such as the frog, the retina extracts information and presents the brain with somewhat abstracted information about the environment. For example, a group of physiologists at the Massachusetts Institute of Technology have shown that certain neurons in the frog's optic nerve carry information about the presence of small, buglike objects in the environment. Others seem to register the darkness of the environment, and still others respond to large objects crossing the visual field such as large predators or other enemies. From what we know about the frog's habits, it would appear that this information is quite relevant biologically (Lettvin, Maturana, McCulloch, & Pitts, 1959).

The story is somewhat different in higher animals such as the cat and the monkey. In these animals the abstraction of relevant information seems to occur mostly in the visual areas of the cerebral cortex. Hubel and Wiesel at Harvard University have found that individual neurons in the cerebral cortex of cats and monkeys respond selectively to lines and edges, and seem to be particularly sensitive to the orientation of these figures and to whether or not they are moving in a particular direction. Other neurons seem to respond to enclosed figures such as squares and rectangles. In other words line and edge information contained in the optic array seems to be quite important, and the visual systems of those mammals that have been studied seem to be organized to extract that kind of information (Hubel & Wiesel, 1962, 1968).

Thus far no one has discovered cells responsive to particular gradients of texture, as described earlier. Whether or not such will be found is another question. This type of research is expanding quite rapidly at present, and before long we should have a better picture of how these processes work.

EXTRACTION OF WAVELENGTH INFORMATION

Recall that the optic array contains different distributions of wavelengths, depending upon the absorption characteristics of objects in the environment. For animals possessing the necessary pigments in their cones, the distribution of wavelengths is potential information about the color of objects.

For the human observer the color experience has three aspects: hue,

Discriminating Colors with the Skin

Most of us need visual systems in order to discriminate one color from another. However, every now and then, there is a report of someone who apparently can discriminate colors with the fingertips, while blindfolded. These reports have met with considerable scepticism in the scientific community, and rightly so. The controls necessary to demonstrate unequivocally that a subject is discriminating with his fingers and not with his eyes, or on some other basis (e.g., subtle cues from the experimenter) are quite extensive, and not all research has employed them.

Several years ago a subject who claimed to have such an ability came to the attention of four psychologists, Zavala, van Cott, Orr, and Small, who made an extensive study of her ability and published the results in 1967.

Zavala et al. provided the subject with various types of discrimination tasks. In one of them, she sorted poker chips of different colors while blindfolded. For further assurance that she could not see, she was tested while reaching under a box and bibb arrangement that completely obstructed her view of her hand and arm. She was able successfully to sort, at a level of performance above that expected by simply guessing, pairs of poker chips of which one was red and the other was another color. In other words, she could discriminate red from white, and red from blue. She could not discriminate blue from white. In another test she was able to determine whether or not a beam of light was shining on her hand. The color of the light was varied, and it was passed through a heat shield and 5 inches of water in order to absorb heat, which could conceivably affect the discrimination. In this test the color of the light did not make any difference. She was able to indicate reliably better than chance whether or not the light was on, however.

A third test involved the identification of playing cards. A new deck of cards was unsealed and shuffled in an automatic shuffler. The subject was then given the cards and asked to identify the top card by suit and number. On 309 such trials she was correct on 5.82 percent of them, reliably better than the level of 2 percent that would be expected by chance.

On each of the tests this subject was compared with three control subjects, who went through the same procedures but without having as many trials as the main subject. Tests indicated that the main subject was reliably better than the control subjects for all of the tests. As a further check, the investigators asked a professional magician to observe the subject while she was making her discriminations, on the possibility that he might notice some "cheating" of which the experimenters might perhaps be unaware. He discovered none.

What is the basis for such discrimination? The authors discuss various

possibilities and come to the tentative conclusion that the discrimination is based on the differential cooling of the skin by differently colored stimuli. In other words, objects of certain colors will carry more heat away from the skin than will objects of other colors. If this were so, then discrimination would be better when there is a larger difference in temperature between the skin surface and the test objects. Having measured the temperatures carefully at each session, they found that there was a reliable positive relationship between the temperature differential between the skin and the surround and the subject's performance. That is, the larger the temperature differential, the better the performance.

What is the extent of this phenomenon? Does everyone have the capability to some degree, or is it present only in a very few individuals? Actually, one of the control subjects in the Zavala et al. study did better than chance on several of the experimental tasks, in contrast with the other two controls, who apparently could not make the discriminations.

What do these findings mean? Actually, it is difficult to say at the moment. It would seem difficult to dismiss the Zavala et al. findings as being simply the result of chance, although there is always that possibility. Perhaps the main point to be made at the moment is that careful observation can lead one to the discovery of phenomena that might otherwise go unnoticed. Such discoveries will ultimately be very important in our efforts toward a more and more complete view or how organisms process information from the environment. (Zavala, van Cott, Orr, & Small, 1967).

saturation, and lightness. These experiences are perhaps best illustrated by means of the *color solid*, shown in Plate 1. Differences in hue are represented by different locations on the perimeter of the solid; saturation, which is the *amount of hue* relative to gray, is represented by the distance out from the axis of the solid; and lightness is represented by the vertical distance along the axis.

Hue and saturation depend upon the composition of wavelengths in the optic array, and may be understood in terms of the principles of color mixture.

Color Mixture. All of our hue and saturation experiences result from various combinations of excitations in just three kinds of receptors, which contain different pigments. The three pigments are *erythrolabe* (which absorbs more red than other wavelengths), *chlorolabe* (which absorbs more green), and *cyanolabe* (which absorbs more blue). The wavelengths absorbed by these pigments correspond to the three primary colors red, green, and blue, and a mixture of these three colors can produce all of the hues we are capable of experiencing.

The hues produced by various mixtures may be understood in terms of the color circle, shown in Plate 4. Equal mixtures of the three primaries

will result in white. Mixtures of two of the primaries will result in some color in between the two, depending upon their relative amounts. Experience of the different hues is explained as follows: "Red" is signaled by a lot of activity in the cones containing erythrolabe; "green" by the cones containing chlorolabe, and "blue" by the cones containing cyanolabe. "Yellow" is signaled whenever there is an equal amount of activity in both erythrolabe and chlorolabe cones, "turquoise" by equal activity in the cholorolabe and cyanolabe cones, and "white" by equal activity in all three cones.

Saturation depends on the number of wavelengths in the mixture, with more wavelengths producing less saturation. Thus, the more different receptors that are active, the less will be the saturation. White, resulting when all three receptors are active, is of course completely unsaturated.

The idea that all of our color experiences result from excitations in just a few types of receptors, each responsive to one particular color, goes back to the laws of color mixture devised by Sir Isaac Newton in his book *Opticks,* published in 1704. These laws were formulated into a theory of color vision in the first decade of the nineteenth century by Thomas Young, who suggested that only three receptor types were involved. Hermann von Helmholtz later elaborated the theory, which became known as the Young-Helmholtz trichromatic theory of color vision.

Color Contrast. The color circle is arranged so that hues that are opposite one another on the circle are also opposite physiologically. Such pairs of colors are said to be *complementary* and, when mixed together, will produce white. The complement of a color may also be induced by surrounding a gray area with the color (Plate 2). The gray area will appear to have the hue of the complement of the surround. The reason for this phenomenon is that the neurons in the retina and in higher centers respond in opposite ways to complementary colors. For example, some neurons that increase their rate of firing in response to red light will be inhibited, i.e., will reduce their rate of firing, in response to blue-green light. These so-called opponent processes have been hypothesized for a long time, since the physiologist Ewald Hering proposed them as a basis for color vision in the last century, but in recent years neurons which actually respond that way have been discovered in the visual system.

Lightness. The lightness of an object depends upon the amount of light reflected by it, relative to that reflected from its background. Under ordinary conditions a white piece of paper will reflect about 80 percent of the light falling on it, while a piece of black construction paper will reflect perhaps 20 percent, and a gray object about 40 percent. The background is quite important, however. A medium gray object seen against a white background will appear to be somewhat darker than the same object seen against a black background (Plate 3). This phenomenon is known as *lightness contrast* and is basically similar to contrast in hue, in that it depends upon the operation of inhibitory processes in the nervous system. On the other hand,

as long as the background remains constant in lightness, increasing the amount of light reflected from the object will increase its lightness. In other words, objects that reflect more of the light falling on them will appear to be lighter than those that reflect less.

Afterimages. Another form of color contrast, sometimes called *successive color contrast*, is the negative afterimage. Look at Plate 5 and follow the instructions. You should see four afterimages, one each in the four corners of the square on the right. Each should be the complement of the color in the corresponding location of the square on the left.

The yellow afterimage is explained as follows: Blue light stimulates and therefore fatigues the receptors for blue, which therefore fire less strongly. Receptors for red and green are less affected. When you fixate the "X" on the right the gray color of the square reflects all wavelengths equally. However, the blue component of that light is not as effective as the red and green components because of the fatigue mentioned above. Since the red and green components therefore predominate, and since red and green, when mixed by combining light of different wavelengths, yield yellow, you see a yellow afterimage. (You devise a similar explanation for the other three afterimages.)

Mechanical Energy

Mechanical energy results from physical movement as well as static forces with the potential for movement. The source of the energy may be a distant object whose movements produce vibrations in the air or water; it may be the organism itself, moving its limbs relative to each other and itself relative to the surround, or it may be an object contacted so as to deform the skin momentarily. Static forces are generated when rigid objects come into contact with other rigid objects, e.g., the soles of one's shoes against the pavement. Deformation happens when nonrigid objects such as one's body come into contact with rigid objects, such as a chair. In all cases there is potential information, since the events specify objects and/or one's relationship to them.

Gravity

Gravity is a universal force, as far as earth-bound creatures are concerned, for all are affected by it at all times, and gravity profoundly influences one's orientation to the world. For the animal, there are a number of specific consequences of gravity. First of all, traveling on a rigid surface causes a deformation of whatever parts that come into contact with the surface—the soles of the feet, for example. Receptors in the skin (see Figure 5.6) sense the pressure associated with this deformation, and contribute to one's sense of "which end is up." It is significant that in the weightless condition an individual perceives "down" as being wherever his feet touch a rigid object. Thus pressure on the soles of the feet is a potent stimulus for up-down orientation.

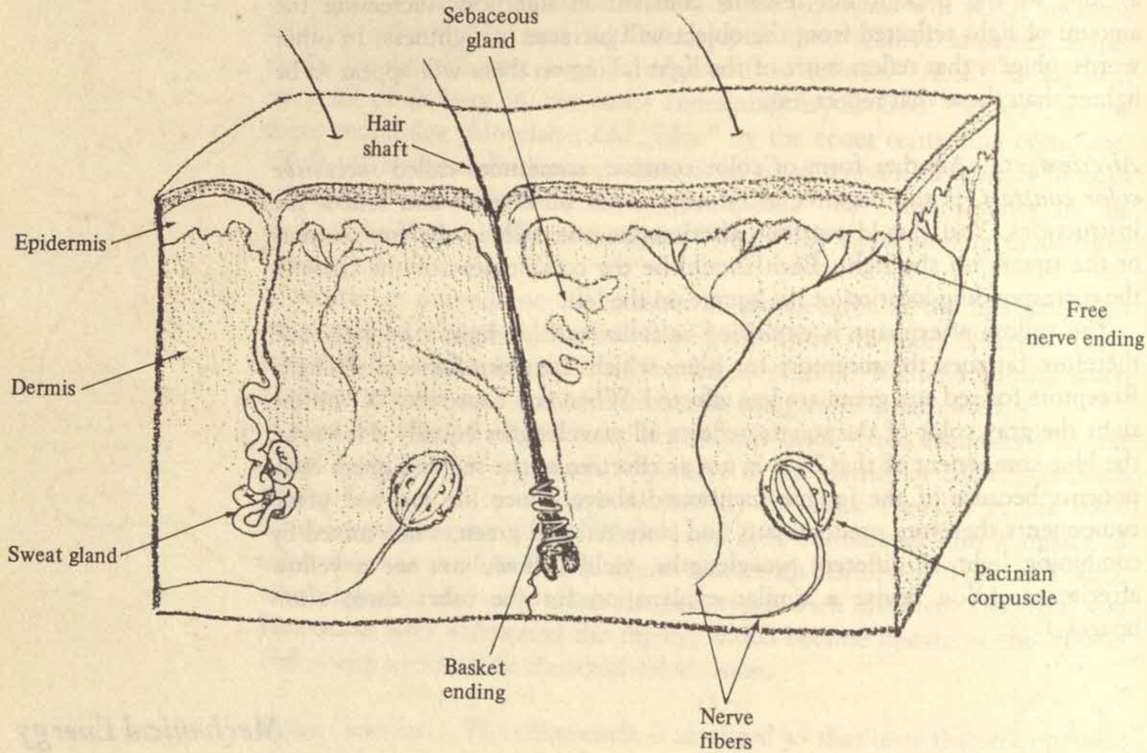
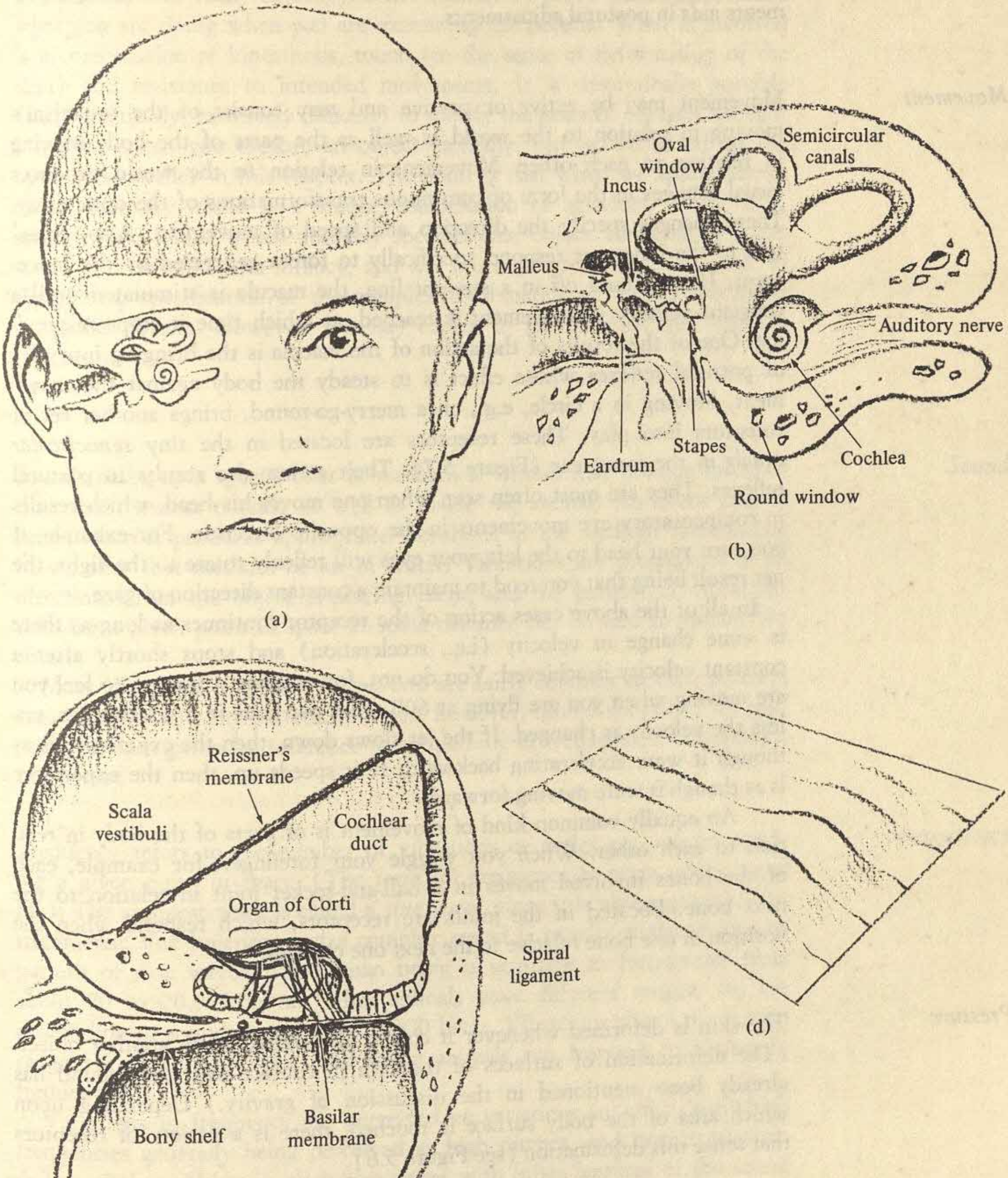


FIGURE 5.6 *A section through hairy skin. Three kinds of receptors are shown. Basket endings surround the shafts of hairs. Free nerve endings are located in the superficial layers, and Pacinian corpuscles are in the deeper layers.*

Gravity also affects the relationships between tissues within the body cavity—the position of the stomach relative to the diaphragm, for example. These relationships can be sensed, at least in a gross sort of way, and provide further information about orientation.

FIGURE 5.7 *The auditory and vestibular systems. (a) The location of the labyrinth in the head. (b) An enlarged view of the labyrinth. Sound waves vibrate the eardrum, which passes the vibrations to the three tiny bones: the malleus, incus, and stapes. The stapes passes the vibrations into the cochlea. The pressure produced at the oval window by the stapes is relieved at the round window. The wave travels the length of the cochlea. A cross section of the cochlea is shown in (c). The Organ of Corti, which sits on the basilar membrane, contains the hair cells, the tufts of which project into the tectorial membrane. The canals are filled with fluid. When the sound wave enters the cochlea, it sets up a traveling wave in the basilar membrane, shown schematically in (d). The wave causes the tufts of the hair cells to bend, thus setting up the electrical activity necessary for generation of an action potential in the fibers of the auditory nerve. The labyrinth also contains the semicircular canals, the saccule, and the utricle, shown in (b), which respond to static and dynamic forces generated by gravity and by movement.*
(a), (b) From Lindsay & Norman, 1972; (c) from Denes & Pinson, 1963; (d) from Rasmussen & Windle, 1960.


Oval
window
Semicircular
canals
Incus
Malleus
Auditory nerve
Stapes
Eardrum
Cochlea
Round window
(b)
(a)
Reissner's
membrane
Scala
vestibuli
Cochlear
duct
Organ of Corti
Spiral
ligament
Basilar
membrane
Bony shelf
Scala Tympani
(c)
(d)

The inner ear also contains receptors (see Figure 5.7), which sense the pull of gravity. The organ is called the *macula,* and it is located within the *utricle* of the inner ear. Its sensitivity to the pull of gravity and to movements aids in postural adjustments.

Movement

Movement may be active or passive and may consist of the organism's moving in relation to the world as well as the parts of the body moving in relation to each other. Movement in relation to the world produces visual changes in the form of continuous transformations of the optic array. These changes specify the direction and speed of movement. Also, receptors in the inner ear respond specifically to forces generated by the movement. If one starts off in a straight line, the macula is stimulated until a constant velocity of movement is reached, at which time it stops responding. One of the results of the action of the macula is the bringing into play of postural reflexes whose effect is to steady the body against the movement. Moving in a circle, e.g., on a merry-go-round, brings another set of receptors into play. These receptors are located in the tiny *semicircular canals* in the inner ear (Figure 5.7). Their action also results in postural reflexes. They are most often seen when one moves his head, which results in compensatory eye movements in the opposite direction. For example, if you turn your head to the left, your eyes will reflexly rotate to the right, the net result being that you tend to maintain a constant direction of gaze.

In all of the above cases action of the receptor continues as long as there is some change in velocity (i.e., acceleration) and stops shortly after a constant velocity is achieved. You do not, for example, continue to feel you are moving when you are flying at 600 miles per hour in a jet airplane, unless the velocity is changed. If the jet slows down, then the experience is as though it were accelerating backward. If it speeds up, then the experience is as though it were moving forward.

An equally common kind of movement is of parts of the body in relation to each other. When you waggle your forefinger, for example, each of the bones involved moves in a ball-and-socket joint in relation to the next bone. Located in the joints are receptors, which respond when the position of one bone relative to the next one changes.

Pressure

The skin is deformed whenever it comes into contact with another object. (The deformation of surfaces of the skin in contact with the ground has already been mentioned in the discussion of gravity.) Depending upon which area of the body surface is touched, there is a variety of receptors that sense this deformation (see Figure 5.6).

Active Touch

Although the skin may passively register things that happen to it, it is also an exploratory sense organ. Appreciation of the shape and texture of an object, for example, may be accomplished by touch alone. If you have a

junk box where old watches, coins, broken pencils, ball point pens that no longer work, paper clips, etc., are kept, close your eyes and reach into the box and see how many objects you can identify by touch alone; also, notice what you are doing when you are examining the objects. What is involved is a combination of kinesthesis, touch (in the sense of deformation of the skin) and resistance to intended movements. It is theoretically possible (but, practically, extremely difficult) to specify the array of energies brought into play when you explore an object tactually, just as we described the optic array earlier in this chapter. The point is that when we appreciate an object tactually, there is a unique combination of activities in the skin, muscles, and joints, which uniquely specifies that object. Research in active touch is presently in its infancy, and not much progress has been made in the precise specification of the complex combination of events specifying particular objects. However, we may expect to see more of this work in the future.

Sound

Sounds make up a special class of mechanical stimuli that provide information about events outside as well as inside the animal. An event can be heard when it produces appropriate vibrations in the medium surrounding it, whether that medium be air or water. Vibrations are propagated in all directions from the object producing them, and the pattern of vibrations reaching a given point in space at some distance can be said to specify the object.

Most vibrations to which we respond are fairly complex in their patterns (see Figure 5.8). Any pattern, or wave, however, can be simplified for purposes of description by reference to its pattern of *frequencies, amplitudes,* and *phases.*

FREQUENCY

Frequency refers to the number of vibrations or cycles per second reaching a given point in space. (The term for frequency is hertz, abbreviated Hz). The simplest wave is called a *sine* wave, since it is also a graph of the trigometric sine function, and a complex sound is usually analyzed into its pattern of sine waves. The human being is sensitive to frequencies from about 20 to 20,000 hertz. Other animals have different ranges, the bat responding to sounds upward of 50,000 hertz. Vibrations above the human range are called *ultrasonic,* and many animals can respond to ultrasonic frequencies.

Variations in frequency are perceived as variations in *pitch,* with high frequencies generally being perceived as high pitches, and low frequencies as low pitches. Although pitch also varies with other features of the sound wave, it is primarily determined by frequency.

AMPLITUDE

Amplitude is the amount of vibration, or amount of pressure produced by the wave. It is measured in *decibels.* The number of decibels of loudness

is equal to 20 times the logarithm of the ratio of that sound pressure to a reference pressure, usually 0.0002 dynes per square centimeter. Thus a 10-fold increase in sound pressure is equivalent to an increase of 20 decibels. The amplitude of some common sounds are shown in the figure on p. 133. Differences in amplitude are perceived as differences in loudness.

PHASE

Phase refers to the time of arrival of different components of the sound wave at a given point in space. Components that differ in phase may partially cancel one another out at certain times and partially augment one another at others, so that the resultant is a sound different from either of the components.

COMPLEX SOUNDS

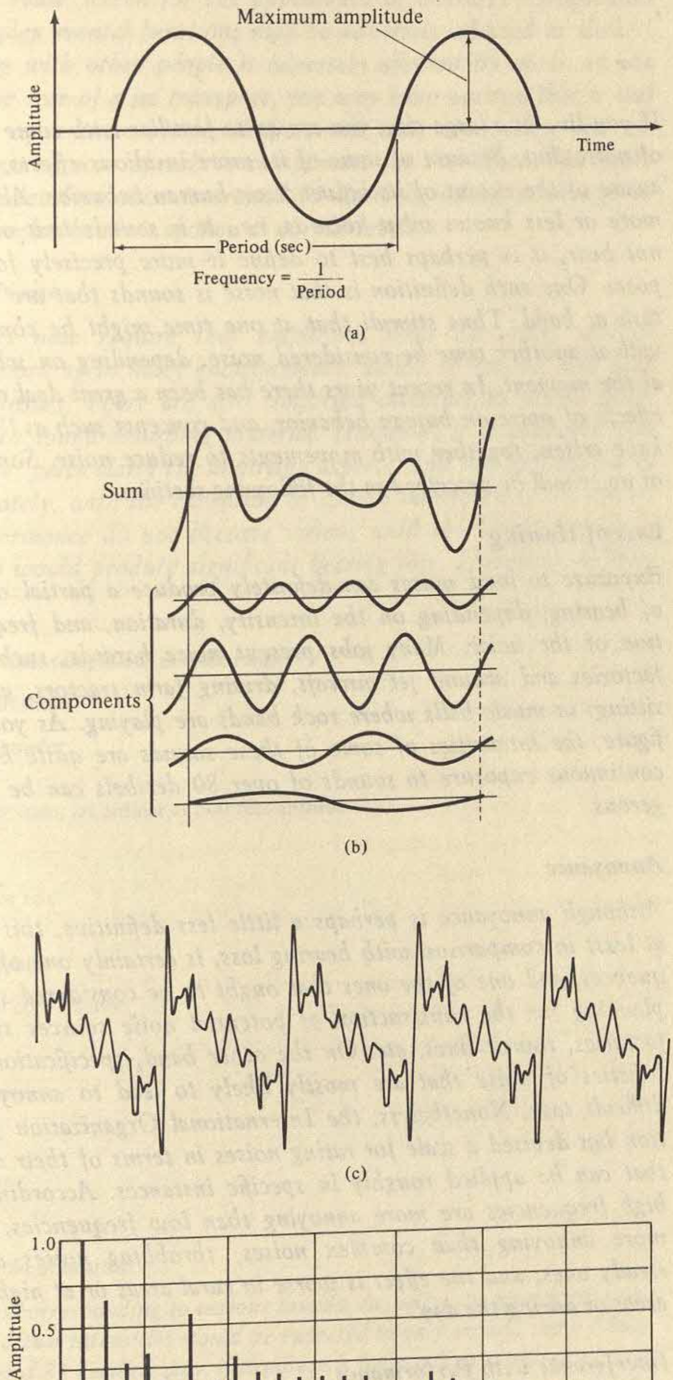
Simple sounds, composed of only one frequency, are called *pure tones*, and sound somewhat like a soft whistle. In complex sounds, composed of different frequencies, each frequency may have a different amplitude and a different phase relationship to the other frequencies. In *musical sounds* the various frequencies are usually multiples of the lowest, or *fundamental,* frequency. These higher multiples are called *overtones*, or *partials*. Different musical instruments produce different characteristic patterns of overtones, which accounts for their different sound qualities, or *timbre*.

Nonmusical sounds, or noise, differ from musical sounds in that the pattern of frequencies, amplitudes, and phases is quite irregular. An especially important source of (relatively) nonmusical sounds is the human voice carrying on ordinary speech. The generation and perception of speech will be discussed more fully in Chapter 10.

THE ACOUSTIC ARRAY

Sounds are produced by a variety of different events; people speaking or playing musical instruments, birds chirping, grass rustling, rain falling, etc., each of which produces a different pattern of frequencies, amplitudes, and phases. We might say that the pattern of sound waves emanating from a given object *specifies* that object, in the same way that the distribution of light in the optic array specifies objects. The main difference between an acoustic array and an optic array is that, in considering the acoustic array, it is necessary to examine the pattern of waves as it changes *over time*. While an instantaneous pattern of light rays might very well specify an object visually, an instantaneous sound would be heard only as a click. The acoustic specification of objects requires an extended period of time. Unfortunately,

FIGURE 5.8 *Frequency and amplitude. (a) A sine wave. The period is the time to complete one cycle, and the frequency is inversely proportional to the period. The amplitude is the height of the wave at its maximum point. (b) The complex wave in the top line was constructed from a combination of the three waves shown below it, i.e., the pattern of sound pressures shown is the sum of the component pressures. (c) A complex musical sound. This wave was produced by a piano playing middle C. The wave is composed of a large number of frequencies, as you can see in (d), which is the "sound spectrum" corresponding to the wave, i.e., it shows the amplitude of each frequency present in the wave. (b) From Beasley, 1931; (c) Fletcher, 1952.*



Maximum amplitude
Amplitude
Time
Period (sec)
Frequency = $\frac{1}{\text{Period}}$
(a)
Sum
Components
(b)
(c)
1.0
0.5
0
Amplitude
0
500
1000
1500
2000
2500
3000
3500
Frequency
(d)

Effects of Noise on Behavior

If you live in a large city, you are quite familiar with some of the problems of noise, but, because of some of its more insidious effects, you may not be aware of the extent of its influence on human behavior. Although everyone more or less knows what noise is, i.e., it is sounds that one would rather not hear, it is perhaps best to define it more precisely for scientific purposes. One such definition is that noise is sounds that are unrelated to the task at hand. Thus stimuli that at one time might be considered relevant will at another time be considered noise, depending on what one is doing at the moment. In recent years there has been a great deal of interest in the effects of noise on human behavior, and concepts such as "noise pollution" have arisen, together with movements to reduce noise. Some of the effects of noise will be described in the following sections.

Loss of Hearing

Exposure to loud noises can definitely produce a partial or complete loss of hearing, depending on the intensity, duration, and frequency composition of the noise. Many jobs present noise hazards, such as working in factories and around jet aircraft, driving farm tractors, and working (or sitting) in music halls where rock bands are playing. As you can see in the figure, the intensities of some of these sounds are quite high. In general, continuous exposure to sounds of over 80 decibels can be considered dangerous.

Annoyance

Although annoyance is perhaps a little less definitive, this effect of noise, at least in comparison with hearing loss, is certainly one of its main consequences, and one of the ones that ought to be considered specifically when planning for the construction of potential noise sources such as airports, factories, transit lines, etc. On the other hand, specification of the characteristics of noise that are mostly likely to lead to annoyance is quite a difficult task. Nonetheless, the International Organization for Standardization has devised a scale for rating noises in terms of their annoyance value that can be applied roughly in specific instances. According to this scale, high frequencies are more annoying than low frequencies; pure tones are more annoying than complex noises; throbbing noises are worse than steady ones; and the effect is worse in rural areas or at night than in urban areas or during the day.

Interference with Performance

Noise can have deleterious effects on performance of certain kinds of tasks, for instance, if one is performing a watchkeeping task that requires vigil-

ance, in which he is responsible for detecting weak signals of some kind (e.g., watching a radar screen for the appearance of aircraft). Other tasks that require complex mental functions may be adversely affected as well.

Communicating with other people is adversely affected by noise. If you have ridden in the rear of a jet transport, you may have noticed that it was difficult to carry on a conversation at first, and that, eventually, you adjusted the loudness of your speech to compensate for the effect. The problem is noise. The level of noise is around 75 decibels, which is enough to mask much of speech when it is spoken at normal levels.

Protection from Noise

Many work rules now require that employees wear ear plugs and/or ear muffs when working in noisy environments, which, of course, will help prevent hearing losses. There are also concerted attempts to muffle other noise sources with sound-absorbing material. However, it is probable that much of the noise, particularly the annoying aspects, will not be handled in this way. Fortunately, with the exception of speech interference, the effects of noise on performance do not become serious until the level of noise is above that which would produce significant hearing loss. Therefore, as long

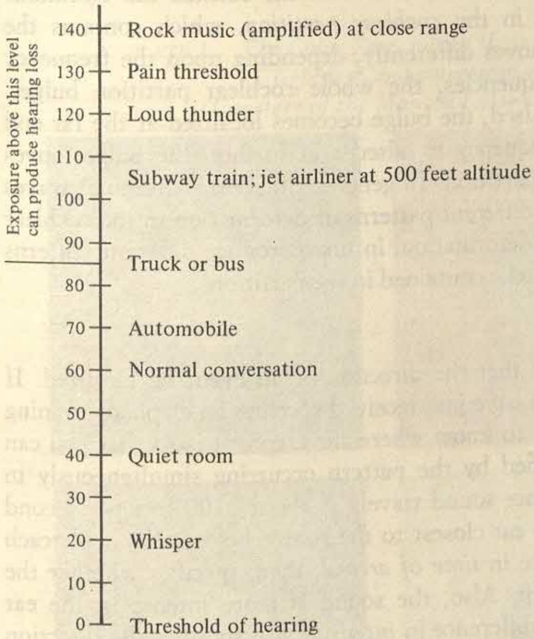


FIGURE A

Decibel values corresponding to various sounds. Actually, the figures given are averages, and the actual intensities would be expected to vary around these values. Sounds above about 85 decibels may, if exposure is for a sufficient period of time, produce significant hearing loss. Actual loss will depend upon the particular frequencies to which one is exposed, and whether the sound is continuous or intermittent.

as safe levels are maintained in a given work environment, the interference will not be too serious.

What is not known, although there has been much speculation about it, is the effect of continuous exposure to annoying noises upon more subtle aspects of psychological and physiological functioning. The question has been raised as to whether noise such as one would encounter on a busy expressway, for instance, would have long-range adverse effects upon one's health. Unfortunately, there are no conclusions that can be drawn, and the research necessary to draw them would be exceptionally difficult to carry out. (McCormick, 1970.)

we cannot go much further in describing the acoustic array at the moment except in the case of human speech, which will be dealt with in Chapter 10.

RECEPTORS FOR SOUND

The essential features of the anatomy of the auditory system are shown in Figure 5.7. Sound waves enter the *outer ear*, produce a pattern of vibrations in the *eardrum*, or *tympanic membrane*, whch is transmitted via the three tiny bones, or *ossicles*, to the *cochlea*. In the cochlea the vibrations result in a traveling bulge in the *cochlear partition*, which contains the receptor cells. This bulge moves differently, depending upon the frequency of the sound. For low frequencies, the whole cochlear partition bulges. Then, as the frequency is raised, the bulge becomes localized at the far end of the partition. As the frequency is raised still further, the bulge moves toward the near end of the partition. In general, different patterns of waves in the environment produce different patterns of deformation in the cochlear partition. These patterns of deformation, in turn, produce different patterns of excitation in the receptor cells contained in the partition.

SOUND DIRECTION

Quite often, it is important that the direction of an event be localized. If the pattern of vibrations you have just received specifies an elephant running wild, it would be important to know where the elephant is so that you can avoid it. Direction is specified by the pattern occurring simultaneously in the two ears. First of all, since sound travels at about 1100 feet per second in air, sounds will reach the ear closest to the source before they will reach the other ear. This difference in *time of arrival*, then, specifies whether the sound is to the left or right. Also, the sound is more intense in the ear nearest the source, and this difference in *intensity* also specifies the direction of the sound.

The distance between the two ears also produces a difference in *phase relationships* between the two ears. The left ear may, for instance, be stimulated at a given instance by the trough of the sound wave, with maximum negative pressure, while the right ear at the same instant is stimu-

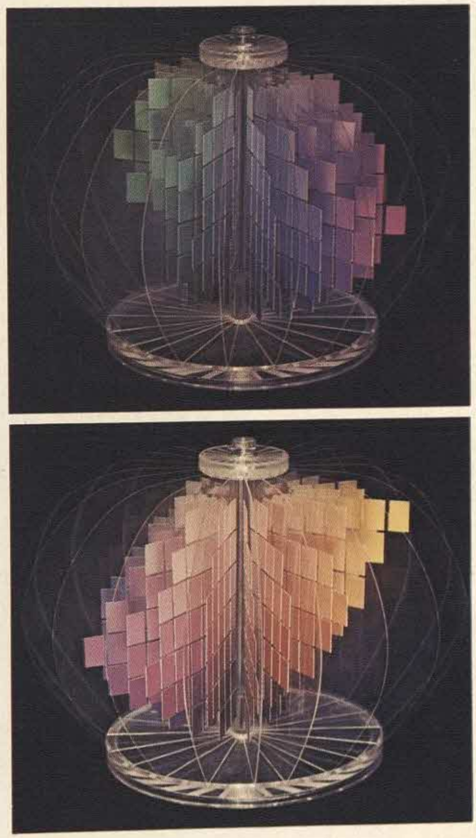


PLATE 1. *The Color Tree, which shows how hue, lightness, and saturation are related. (Courtesy of the Munsell Color Company.)*

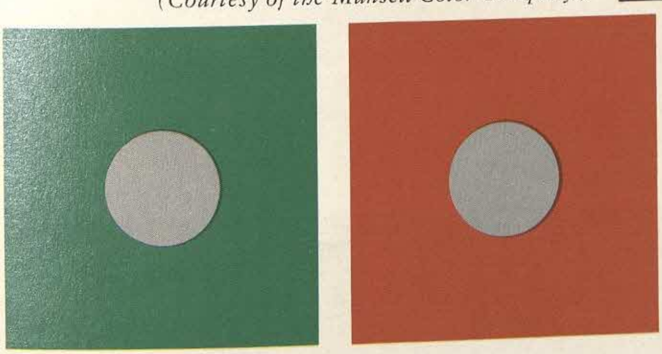


PLATE 2. *Color contrast. The gray circle in the center is the same in the two panels, but appears reddish in the left and bluish in the right panel.*

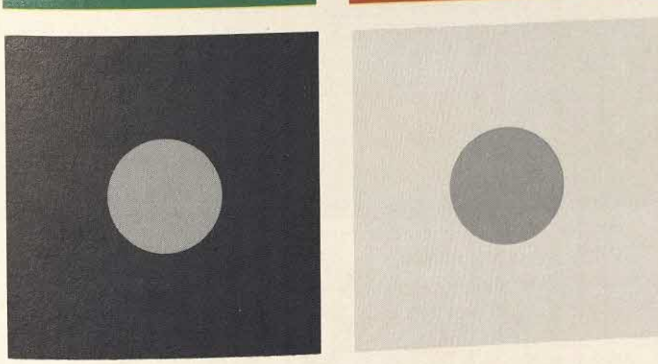


PLATE 3. *Lightness contrast. The two grays are the same, but appear of different lightnesses against the two different backgrounds.*

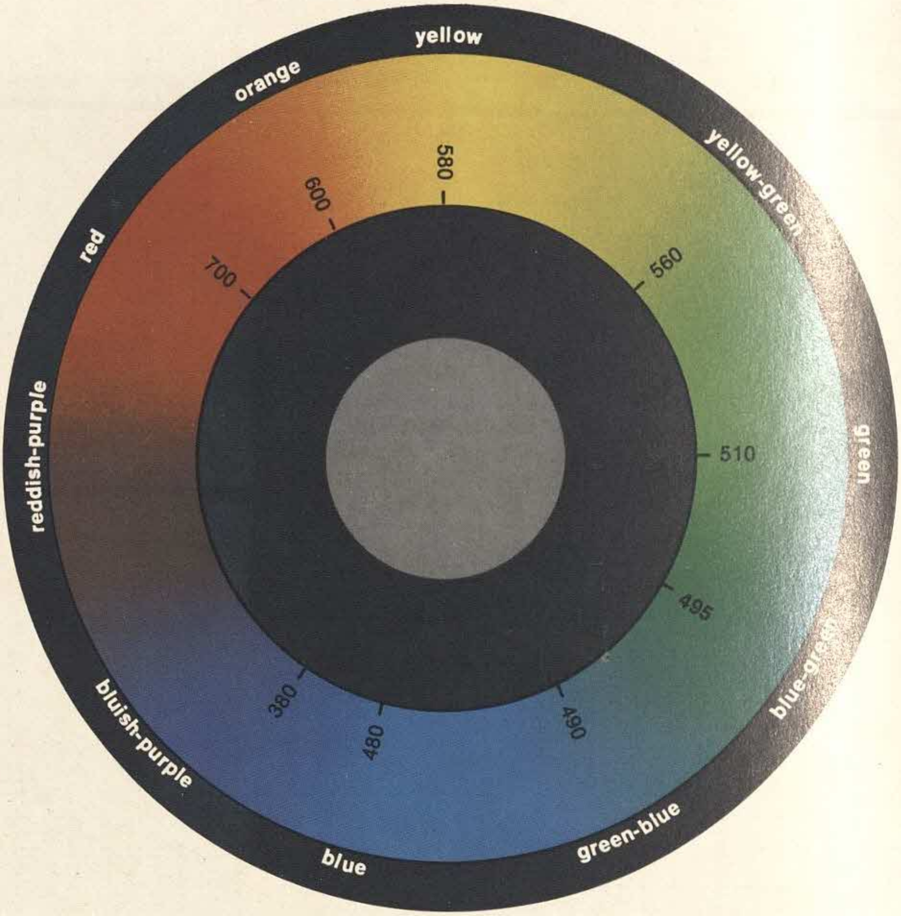


PLATE 4. *The Color Circle. Colors opposite one another on the circle are complementary. When mixed together they produce gray or white. Purples and some reds are nonspectral (not contained in sunlight) and can only be obtained by mixing special colors. (From Krech, Crutchfield, and Livson, 1974.)*

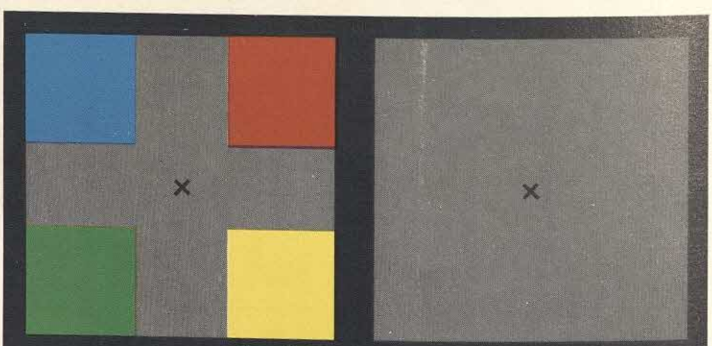


PLATE 5. *Afterimages. Stare at the "x" in the square on the left for at least 30 seconds. Then shift your gaze to the "x" in the gray square on the right. Note the colors that you see in the corners of the right square. (From Krech, Crutchfield, and Livson, 1974.)*

lated by some other portion of the wave. This phase difference is partly responsible for localization of continuous sounds.

Further precision in localization is given by changes in the time of arrival and intensity differences produced by head movements. If a sound source is to your right and slightly behind you, if you move your head to the right the intensity in your right ear will increase, whereas, if you move your head to the left, the intensity in the right ear will decrease. This change in intensity with head movements also specifies whether the source is in front or behind you. (What would happen in the above example if the source were in front and to the right?) Localization as to up or down is not as precise as horizontal localization. However, there is some evidence that we tend to localize high frequencies as being up, and low frequencies as being down. This type of localization, of course, does not serve to maintain contact with the environment because there is not a perfect relationship between frequency of the source and its elevation. Mice on the ground and airplanes in the sky would be quite poorly localized if we depended upon this mechanism.

Temperature

Not only do we live in a sea of light and various mechanical energies, but also we are confronted with increases and decreases in heat, and each organism seems to have a definite set of requirements with respect to this kind of energy. Human bodies, for example, do not function well if the internal temperature is very much different from 37°C (98.6°F). Objects that are too hot or too cold are avoided, and, if allowed to contact the skin for long periods of time, may cause damage to the tissues. Extreme air temperatures are also usually avoided, moderate climates being more preferred than very cold or very hot ones. From the point of view of the subject of this chapter, which is maintaining contact with the environment, it is convenient to consider separately the aspects of temperature mentioned above: body/environmental temperature and object temperature. While the two are related to one another in real life, in some respects they seem to involve different types of functioning.

Body and Environmental Temperature

This topic is best dealt with under the general rubric of motivation, since the main consequences of changes in body temperature are behavioral rather than perceptual. Our perception of changes in body temperature are at best vague and imprecise, and are probably largely the consequence of the operation of the automatic processes that control temperature. Such processes include sweating, shivering, erection of the hairs (which, in furry animals, would fluff the coat and decrease the heat loss from the skin), panting, decreased motility, etc., which are brought into play if the body becomes too warm or too cold. These actions are under the control of sensors in the

hypothalamus which, when activated by increases or decreases in blood temperature, serve through their neural interconnections to bring about the necessary changes. Receptors for cold in the skin may also be involved in heat retention, although their precise role is not generally agreed upon. Temperature regulation, then, is one of a number of *homeostatic* mechanisms (see Chapter 12) that serve to maintain a relatively constant internal environment. Perceptually, it is quite difficult for one to tell what his temperature is without a thermometer or some other objective device, and abnormal temperatures are usually experienced as vague discomfort.

Object Temperature

Object temperature is another function of the haptic system described above which, as you have seen, is concerned with the perception of object properties. Although the receptors for temperature have not been unequivocally identified, they are known to lie approximately 0.2 millimeters below the surface of the skin (Kenshalo, 1971).

A question that has been raised over the years is whether temperature is registered by one, two, or perhaps three different receptor systems. The sensations in question are those of cold, warmth, and heat; it was thought for a long time that cold and warm involved separate neural systems, with heat being produced by the combined stimulation of both systems. It is true that if you stimulate small spots on the skin, you will elicit cold sensations from some of them and warm sensations from others, and you may even elicit "heat" from stimulation of a cold and a warm spot together. (You might try to demonstrate this phenomenon yourself.) However, at this point these phenomena have not been adequately explained by a complete theory of temperature sensitivity.

The skin is a rather poor measuring instrument for absolute temperature because of the phenomenon of *adaptation*. The simplest demonstration of this fact can be made as follows: Take three jars. Fill one of them with cold water, one with hot (but not scalding) water, and the third with water that feels neither hot nor cold. Place your right hand in the hot water, and your left hand in the cold. After 30 seconds place both hands in the neutral water. Your right hand will now feel that the neutral water is cold, while your left hand feels that it is hot. What has happened is that the temperature of the skin was lowered in the one case and raised in the other so that the neutral water had a cooling effect on the one hand and a warming effect on the other. Apparently, a change in temperature from the existing skin temperature is sufficient to excite the receptors.

Chemical Energy

Registration of chemical energy, like registration of light, sounds, etc., is an important aspect of the life of all animals. The chemicals may be airborne, volatile substances, or they may be dissolved in liquids. In both cases the chemical aspects of the environment are potent motivators for behavior,

and their discrimination is quite often critical for survival. Chemical sensitivity is involved in discriminating the acceptability of foods, mates, and air to be breathed. In aquatic animals the acceptability of different areas of water is determined by chemcal sensitivity.

In the case of foods, both the volatile and the liquid chemical aspects are critical. The "taste" of a steak or a cup of coffee, for example, is a complex response to both airborne and liquid chemicals with much more of the "taste" being due to volatile chemicals (i.e., to "smell"), than is usually realized. You may recall that when you had a cold, foods just did not taste the same. Actually, there was probably no change in the tongue itself, but the contribution of the olfactory system was considerably reduced by congestion in the nasal passages. A more satisfactory demonstration is to have a subject close off his nose with a clothespin, and then attempt to discriminate small pieces of apple, onion, and potato placed on the tongue. It is a very difficult discrimination to make in the absence of smell but is quite easily accomplished with the aid of olfaction. Another important contributor to "taste" is the haptic system of the mouth. Textures, hardnesses, elasticities, and temperatures make a large difference in the way foods taste. Just imagine the difference in taste between a tossed salad served in the usual manner and one that is first ground up in a blender.

Chemoreceptors

Anatomically, the senses of taste and smell are quite distinct. The receptors for chemicals in solution are located in tiny organs on the tongue, called taste buds (Figure 5.9), which line the sides of the small bumps, or papillae, on the tongue. Most of the taste buds are located at the tip, sides, and back of the tongue, with very few buds on the top surface. Infants have taste buds also on the insides of the cheeks, but they seem to disappear with maturation. The receptors for airborne chemicals are located in the upper reaches of the nasal cavity, in a patch of skin called the olfactory mucosa (Figure 5.10). Unless a very deep sniff is taken, most substances reach the olfactory mucosa only by means of eddy currents generated by the air movement occurring during breathing. The olfactory receptors are quite sensitive, however, being able to detect extremely small concentrations of certain chemicals. Even the human olfactory system, which is less sensitive than that of many other animals, is more sensitive than the best chemical apparatus available for detecting minute quantities of chemicals (Mozell, 1971).

Basic Qualities

The classical accounts of taste have suggested that there are only four basic taste qualities—sweet, salt, sour, and bitter—and that all tastes are some combination of these qualities. However, it is quite unlikely that an animal very often encounters such a pure quality in real life (except perhaps a deer at a salt lick). There is also evidence that if the analysis into basic qualities is applicable to human tastes, it is probably not completely applicable to the taste sense in animals. Cats and opossums, for example, give evidence that water is just as basic as any of the other qualities.

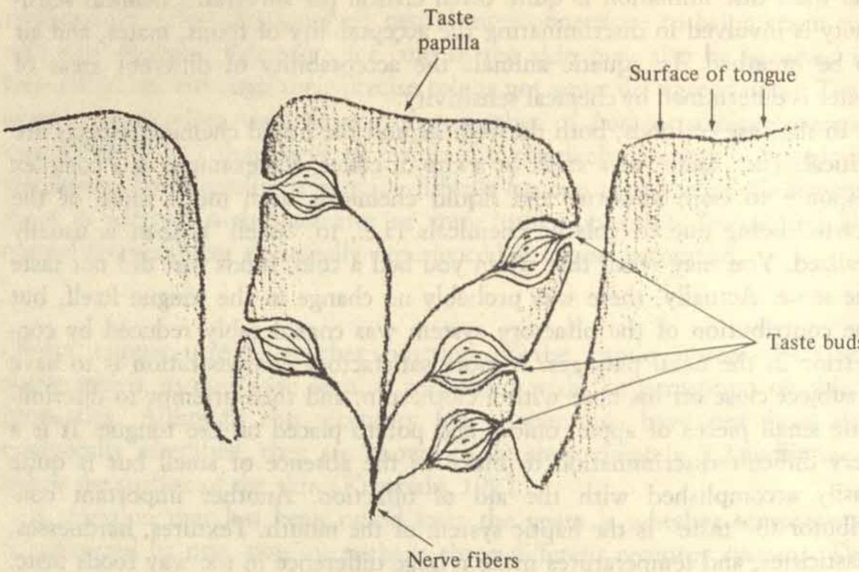


FIGURE 5.9 *A taste papilla, with taste buds. Solutions flow over the surface of the tongue and into the trough surrounding the papilla. The tips of the hair cells that make up the taste buds project through an opening into the trough, where they sample the contents of the solutions.*

Several attempts have been made to determine the basic smell qualities. None of them works very well, in the sense of being able to predict subjects' judgments of various smells.

Equally unsuccessful have been attempts to determine just how the taste solutions bathing the tongue are registered by the receptors. Substances that are structurally quite dissimilar frequently taste the same. For example, table sugar (sucrose), saccharin, and lead acetate (which is poisonous) all taste sweet. Other substances taste both bitter and sweet, depending upon whether they are applied to the tip of the tongue (sweet) or the back (bitter).

Pain

The previous discussion has focused upon the obtaining of information about the internal or external environment through response to patterns of various kinds of energy. In addition, some forms of stimulation may produce a second type of response that has motivational implications; i.e., some stimuli are painful, resulting in avoidance or escape behavior. Pain can be produced by very strong stimuli, including very intense lights, loud sounds, intense probing of the skin, etc., as well as by stimuli that damage bodily tissues, including chemicals, heat, etc.

Pain can be classified into basically two categories, with many variants of each. One category is bright pain, such as would be produced by a needle prick, and the other is deep pain, as might be produced by excessive

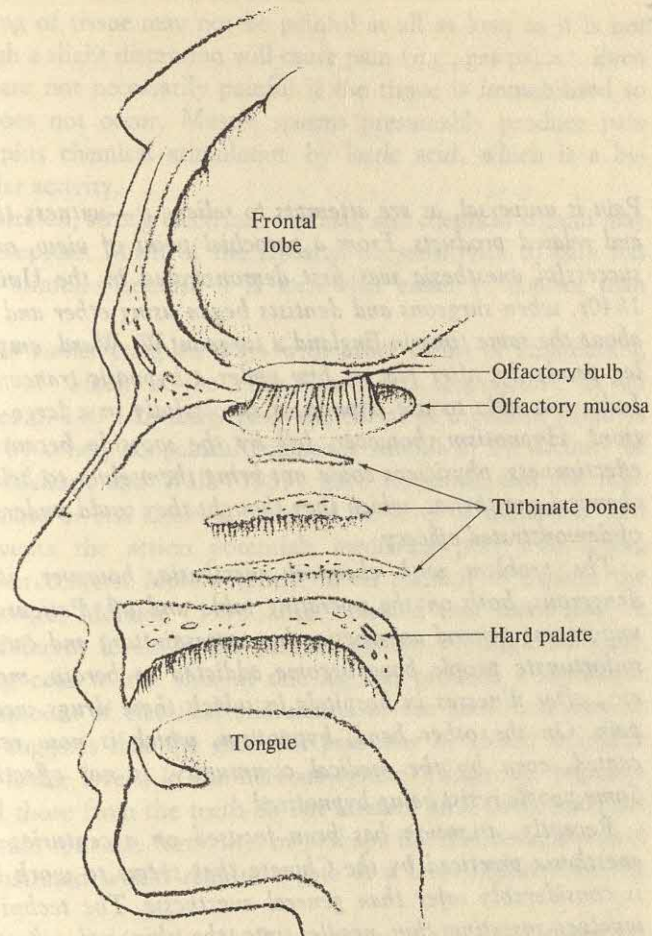


FIGURE 5.10

The location of the olfactory receptors. The olfactory mucosa, which contains hair cells (see Figure 4.1), is located just below the frontal lobes of the brain. Ordinarily, air currents reach the mucosa in the form of eddy currents wafting around the turbinate bones. When, however, one takes a large sniff, air is drawn over the mucosa.
From Pfaffman, 1948.

pressure on a muscle, an especially irritating hypodermic shot, a toothache, or a headache. Bright pain that persists may take on a burning quality and become more unpleasant, but it is still different from deep pain. Deep pain, when sufficiently intense, can result in other physiological consequences such as nausea, sweating, lowered blood pressure and decreased heart rate (i.e., shock).

The receptors for pain are generally thought to be free nerve endings in the skin (Figure 5.6) and muscles. The stimulus for them seems to be stretching of the tissue in which the receptors are found. For example, in

Pain Relief

Pain is universal, as are attempts to relieve it—witness the sales of aspirin and related products. From a parochial point of view, one might say that successful anesthesia was first demonstrated in the United States in the 1840s, when surgeons and dentists began using ether and nitrous oxide. At about the same time in England a surgeon, W. Ward, amputated a patient's leg painlessly, after placing him under a hypnotic trance; James Esdaile in India was able to use hypnotism successfully in a large number of operations. Hypnotism, however, fell by the wayside because, in spite of its effectiveness, physicians could not bring themselves to believe in it, and the chemical anesthetics, which they thought they could understand better, were of demonstrated efficacy.

The problem with chemical anesthesia, however, is that it can be dangerous, both on the operating table and off. Patients have died while undergoing general anesthesia, due to respiratory and cardiac failure; other unfortunate people have become addicted to heroin, morphine, Demerol, etc., after illnesses in hospitals in which these drugs were used to relieve pain. On the other hand, hypnotism, which is now reasonably well accepted, even by the medical community, is not effective for everyone. Some people resist being hypnotized.

Recently, attention has been focused on a centuries-old technique for anesthesia practiced by the Chinese that seems to work in most cases and is considerably safer than general anesthesia. The technique, acupuncture, involves inserting thin needles into the skin and vibrating them. If the needles are in the right place, then extreme forms of surgery, such as open heart surgery, lung removal, etc., can be performed painlessly, while the patient is awake, without any of the dangers of general anesthesia.

The effectiveness of acupuncture is not well understood. The Chinese explanation for it refers to the forces of yin and yang (the feminine passive principle and the masculine active principle that are the basis of existence) which may get out of balance and whose balance is restored by acupuncture into the channels in which the forces flow. This explanation and the needle technique are quite foreign to Western ways of thinking. The efficacy of acupuncture, however, seems to fit into a theory of pain sensitivity advanced by Melzack and Wall (1965), in which nonpainful peripheral stimulation is assumed to control whether or not pain impulses are able to reach higher centers and be perceived (see p. 141). On the other hand, recent evidence indicates that acupuncture does not reduce sensitivity to painful stimuli, per se, but, rather, reduces the painful quality of the stimulation so that it is not so bothersome (Clark and Yang, 1974). At this point in time there is much interest in the procedure so that a more thorough understanding of acupuncture may emerge in the near future.

the gut, the cutting of tissue may not be painful at all as long as it is not distended, although a slight distention will cause pain (e.g., gas pains). Even cuts on the skin are not necessarily painful if the tissue is immobilized so that stretching does not occur. Muscle spasms presumably produce pain through stretch, plus chemical stimulation by lactic acid, which is a by-product of muscular activity.

In addition to stretch, strong electrical, thermal, and chemical stimuli may excite the pain receptors. Much of the research on sensitivity to pain has used heat as the stimulus because it is somewhat easier to control than other stimuli.

Pain interacts in rather complex ways with other forms of stimulation, one manifestaton of which is the effectiveness of acupuncture as an anesthetic tool (see p. 140). In many cases the effects of a painful stimulus can be alleviated by other, nonpainful cutaneous stimuli in the vicinity of the painful area. Melzack and Wall (1965) have suggested that the non-painful stimulus more or less closes a "gate" at the level of the spinal cord and thereby prevents the action potentials mediating pain from being passed on to higher centers. More recently, in an attempt to explain the effects of acupuncture, Melzack (1973) has indicated that there may be several gates at different levels in the nervous system. Noting that applications of freezing cold to the shin of one leg can produce a significant elevation in the amount of electrical stimulation of the teeth necessary to produce pain, he suggests that the gates for pain may be closed at higher levels, as well as lower levels, in the nervous system. (Since the impulses from the shin and those from the teeth do not interact until both reach the level of the midbrain reticular formation or perhaps the thalamus, an effect such as he demonstrated would require a gate at a level higher than the spinal cord.)

A variant of bright pain is itch, which has many of the same characteristics. It is apparently brought on by mildly painful stimulation of a persistent sort, and, like pain, can be abolished by additional cutaneous stimulation in the affected area (e.g., scratching).

Summary

The animal maintains contact with his environment by means of several systems of sense organs, which respond to patterns of light, and mechanical, thermal, and chemical energy. These energies either arise from outside the animal or from within. In both cases they specify events of relevance to the animal.

The optic array is formed by light arriving at the eye from the environment. Different aspects of the optic array specify different aspects of the environment. For example, the gradient of texture in the array specifies the orientation of a surface such as a floor or a ceiling. Edges are specified by

abrupt changes in the texture gradient. Different optic arrays are sampled when the head moves, and the regular transformation from one to another array provides additional information about the three-dimensional properties of the environment. Integration of the two different views obtained by the two eyes, or stereopsis, also results in three-dimensional vision.

Color is specified by the pattern of wavelengths in the array, and human color vision is based upon the pattern of excitation of three different types of receptors, called cones, in the retina. One type is sensitive to red, one to green, and one to blue, light. The three attributes of color are hue, which depends upon wavelength; saturation, which depends upon purity of the light; and lightness, which depends upon the amount of light. Cones function only in high levels of illumination. In low levels of illumination we see with a fourth type of receptor: rods. Rods cannot provide for color vision, although they are considerably more sensitive than cones.

Sources of mechanical energies include gravity, movement, pressure, and sound. Orientation with respect to gravity is given by pressure on the body surfaces, such as the soles of the feet, and by stimulation of receptors in the macula of the utricle, located in the inner ear. Movement is sensed by receptors in the semicircular canals of the inner ear, and by relative motion of the joints of the body with respect to one another. Other receptors for pressure are located in the skin and respond to light touch. Active touch involves both joint movement and stimulation of the skin receptors.

Sounds are sensed by receptors in the cochlea located in the inner ear. High and low sounds produce different patterns of stimulation in the cochlea, thus providing for the perception of pitch. Sounds are localized on the basis of differences in time and intensity of stimulation of the two ears.

Body and environmental temperature are only poorly discriminated. Object temperature is specified by the temperature just below the surface of the skin, although there is disagreement about the precise manner in which this temperature is sensed.

Chemical stimuli are sensed by taste buds located in the papillae of the tongue or the olfactory receptors located in the olfactory mucous membrane. There seem to be four basic taste qualities in humans—salt, sweet, sour, and bitter—although it is not known at present how these qualities stimulate the taste buds differentially. Several schemes have been proposed for classification of different smells, although none of them work as well as would be desired, and it is not at present known how chemicals with different odors produce differential activation of the receptors.

Pain is probably the result of stimulation of free nerve endings by lateral stretch, or by chemical or thermal damage. Bright pain arises from the superficial tissues, while deep pain, with its dull, aching quality, arises from deeper structures. The effects of painful stimulation may be modified by cutaneous stimulation elsewhere on the body, although the process whereby this occurs is not understood.

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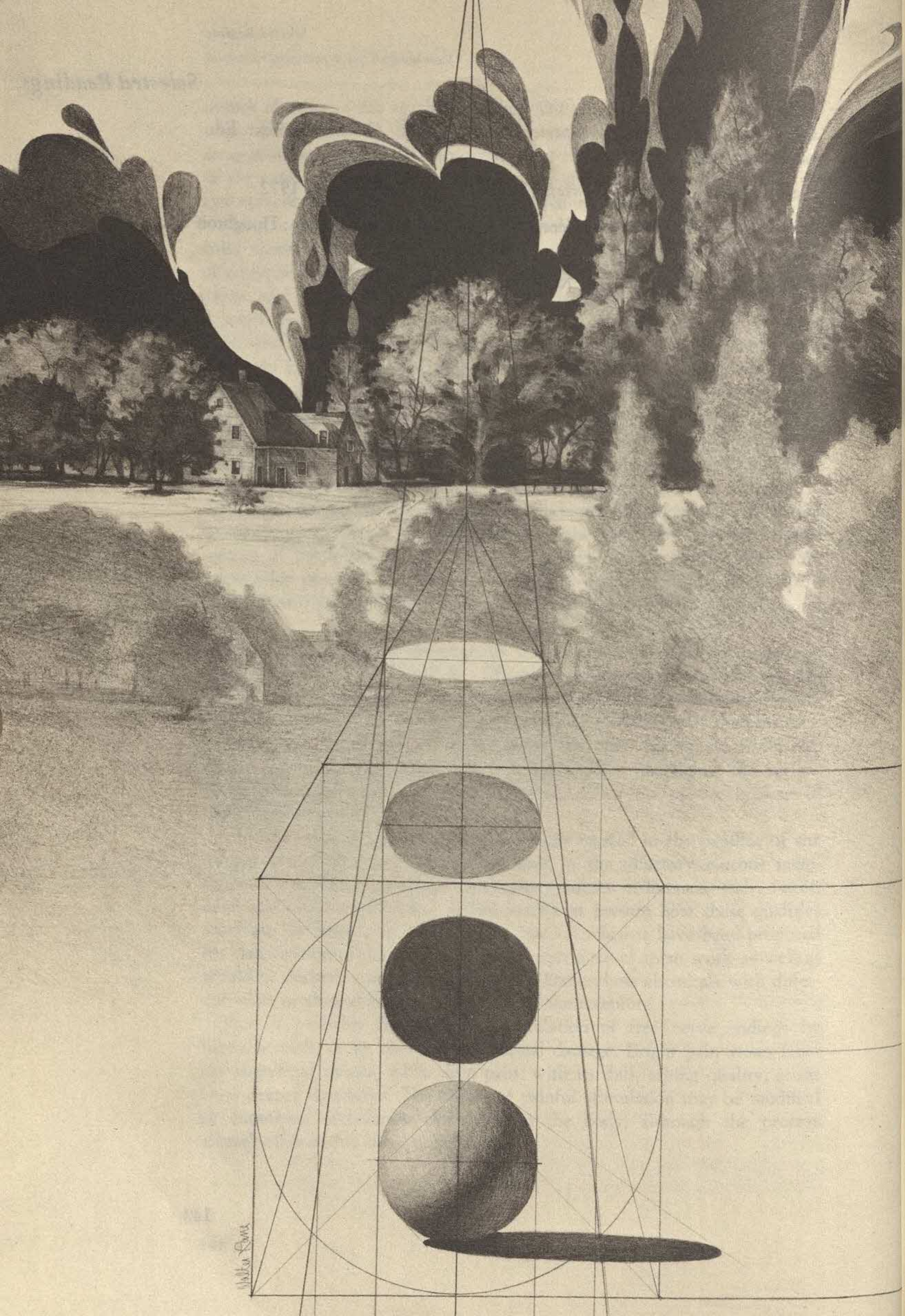


Perceiving

6

You have seen in Chapter 5 how the environment contains information, in that the pattern of energies arriving at the body surface specifies the world outside. In this chapter we consider perception from the point of view of the perceiver. First of all, it will be shown that what one perceives is *organized* into units which more or less hang together, and that one is *selective* about what is organized. Second, experience is more or less *constant,* or invariant, over a range of stimulus conditions. Thus a given object tends to be perceived in much the same way regardless of one's particular angle of viewing it, its distance, or whether it is viewed in daylight or moonlight. Third, perceptual experience is at least partly *learned;* you will see some of the ways in which this learning takes place. Fourth, perception is at least partly *motivated.* As an adaptive function there is a need to perceive, and deprivation has deleterious effects. Fifth, not all perception is *veridical* (related in a reasonably accurate way to the real world). One example of nonveridical perception is illusions, and another is hallucinations. The study of these aspects of perception, especially illusions, has provided some insight into how the perceptual system operates.

Perceptual Organization

Segregation
FIGURE AND GROUND

Look around you. What do you see? If you are in your room studying, you probably see books, pencils, lamps, pictures on the wall, windows, chairs, a bed, shoes on the floor, etc. Your experience is of *objects.* Look again. Notice that as you look at a given object, say, this book, there is something more than just the book, but it is of less importance. It is the surround, or background, against which the book is perceived. Now look at one word on this page. Notice that the word stands out against the background of other words on the page. The whole book, which was once the object of attention, is now a part of the background against which a small part of that book, a single word, is perceived. In general each time you focus your

attention on some feature of the environment, that feature tends to stand out, while other features tend to recede. We can say that experience is organized into *figure* and *ground,* or focus and margin, or focal stimulus and background. Regardless of the particular words used to name the phenomenon, the world is perceived as organized into two main components, the main object of attention and "everything else."

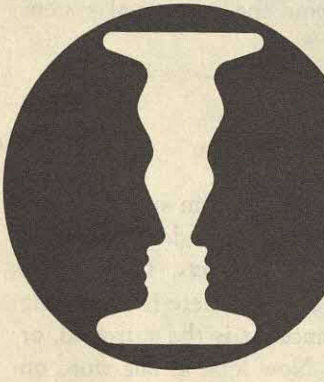
The next time you are at a party with a large number of people, notice how the speech of the person to whom you are listening becomes the focus, against the background of all the other sounds in the room. Also notice that it is hard to keep the conversation in focus if someone nearby says something of interest to you or mentions your name. In dealing with information provided by the environment, we can only handle a limited amount in a given time period. To attend to a lot of different things usually requires focusing first upon one and then upon another thing.

FLUCTUATIONS

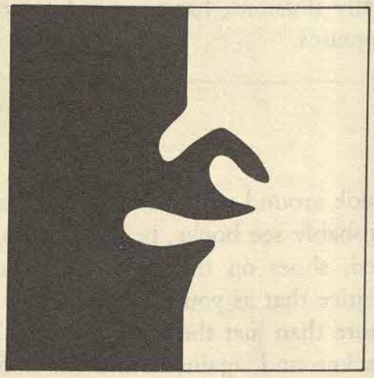
The shift between one figure and another is not always under voluntary control. In Figure 6.1, notice that you can see either a vase in the middle or two faces at the sides. It is quite difficult, and impossible for most people, to see both vases and faces at the same time. As you stare at the figure, notice that all of a sudden there is a shift, and what was once figure is now ground, and *vice versa*. You may also notice certain other features of the figure-ground distinction. First, the contour or border separating the figure and ground seems to belong to the figure, rather than to the ground. The ground, on the other hand, seems to extend continuously behind the figure. Second, the figure has what some psychologists have called "thing-character" to it; i.e., it is more like an object than the background.

PRINCIPLES OF ORGANIZATION

What determines when a given part of the environment will be organized as figure? Recall from Chapter 5 that whatever is in the environment to be



(a)



(b)

FIGURE 6.1 *Figure-ground organization: (a) can be seen as two faces or as a white vase, and (b) can be seen as a black claw or white fingers. Usually, both organizations cannot be seen at the same time, and there is a fluctuation from one to the other.*

perceived is specified in some way in the optic array, and thus the basis for organization is at least partly to be found in the pattern of energies impinging upon the receptor organs. On the other hand, it should be clear from Figure 6.1 that although the pattern of energies in the optic array does not change, the way the picture is perceived (i.e., which is figure and which is ground) does change periodically. Thus organization cannot be completely explained by the optic array; processes operating within the observer must also contribute.

How do the various features of the optic array affect perceptual organization? One of the most complete analyses has been provided by the late Max Wertheimer, one of the founders of the school of Gestalt psychology. Wertheimer proposed certain "laws of organization" that relate to the way patterns are perceived. These laws have been given the names *proximity, similarity, continuation, good form, common fate,* and *closure*. They are illustrated in Figure 6.2. It should be noted that each of the "laws" is preceded by the statement, "Everything else being equal." Since "everything else" is rarely equal, the actual explanation for a given organization will be quite complicated. The laws do, however, help to simplify the matter somewhat. The law of *proximity* states that elements that are close to one another tend to be grouped together. By *similarity* is meant that similar items tend to be grouped together. *Continuation* indicates that elements will be grouped together to form a continuous, as opposed to a broken or discontinuous, figure. *Good form* means that elements which form a simple, symmetrical (i.e., "good") figure will be grouped. *Common fate* is a little more complicated. What it means is that elements that move together tend to be grouped together. This principle holds even when the movement is not real but simply represented. Thus elements that share the same "fate" tend to be grouped together. *Closure* has two somewhat different components, and is thus also somewhat confusing. As a principle of organization, it means that elements will be grouped together to form a closed, as opposed to an open, figure. The term *closure* also refers to what sometimes happens when a partially open figure is viewed casually: the open part is not seen. Thus the observer "closes" the figure himself.

The Gestalt psychologists who developed these laws thought that perception was largely a result of innate brain processes and was very little influenced by learning and other forms of past experience. However, meanings and expectations, which are learned, can also affect organization. Their effects will be discussed in more detail later. For example, Figure 6.3(a) can be seen either as an old woman or a young woman, but not as both at once. In experiments made with this figure, it has been shown that once one of the organizations is seen, it tends to persist. Thus observers who see the old woman first find it difficult to shift to the young woman, and *vice versa*. In Figure 6.3(b) the underlined item is seen as "13" when imbedded in a context of numbers but is seen as "B" in a context of letters. In this case the meaning of the background, or context, plus the expectation that you will see either all letters or all numbers, determine the organization.

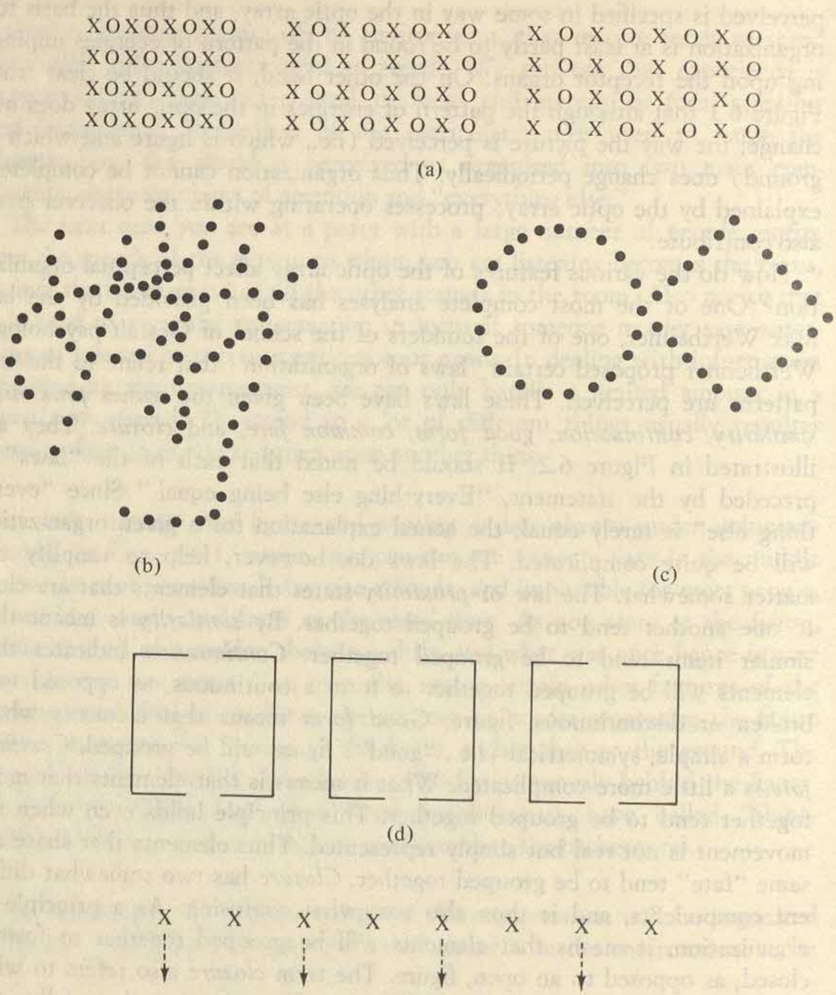


FIGURE 6.2 *Gestalt principles of organization. (a) Proximity and similarity. Note how, as the horizontal separation between the elements increases, there is a greater tendency to organize the figure as columns of X's and O's, rather than rows of XOXOXO, (b) Continuation. (c) Good form. (d) Closure. (e) Continuation: If some X's were to move those that moved together would be organized together.*

Selection and Attention

The figure-ground phenomenon and the laws of organization imply that selective processes are operating within the perceiver to determine which of the multitudinous potential stimuli will be perceived and how they will be related to each other. There are, in addition, other factors that affect what will be attended to and perceived. Many of these factors seem to depend upon learned, *meaningful* relationships between stimuli, the particular kind of stimulation that is *expected,* and perhaps also the relationship between the various potential stimuli and the motivational state of the subject, i.e., whether he wants to perceive something else or not. Obviously,

(a) (b)

FIGURE 6.3

Some stimuli can be organized in more than one way. In (a), you can see either a young woman or an old woman. In (b), whether a "B" or a "13" is seen depends on the context.
(a) From Boring, 1930.

these topics could just as well be discussed under the rubrics of perceptual learning or motivated perception; but, since the main common feature—determining what will be perceived—seems to pertain most closely to the problem of organization, they will be discussed here.

STRENGTH AND REPETITION

Some points are more or less obvious. Stimuli that are very strong, such as loud sounds, prominent visual stimuli, etc., will be perceived. Stimulus strength is a major determiner of what is attended to. Also, something that is new or unexpected will, if it is sufficiently strong, produce a response. Repetition (e.g., as experienced in ratio or television commercials) will also enhance the attention-getting character of stimuli, at least up to a point.

The author lives fairly close to a railroad track, and trains go by quite frequently. However, he is not likely to pay much attention to them, many times not even hearing them, since the repetitive character eventually loses its potency. The trains, of course, are pulled by Diesel engines. However, once or twice a year an excursion train passes, pulled by a steam engine. This train, with its characteristic whistle and other sounds, is always noticed. Apparently, *all* trains must have some effect, but it is ordinarily limited to levels below awareness.

The same must be true when you are able to ignore all conversations at a cocktail party except the one you are engaged in. The other "information" does not reach awareness unless someone across the room mentions your name, at which time you look up. Apparently, most of the information was processed, but you simply were not aware of it.

Extrasensory Perception

Some people are particularly good at guessing. For instance, there is an individual presently being studied at the Foundation for Research on the Nature of Man in Durham, North Carolina, who is quite good at guessing which of several cards is being held up, even when each card is enclosed in a black envelope. Researchers in the field known as parapsychology assume that such people are somehow able to get information about the cards through some channel other than the usual sensory ones you have encountered. The phenomenon is known as extrasensory perception (ESP), which is a term that includes in its meaning telepathy, *or direct, nonsensory communication from one individual to another;* clairvoyance, *or the ability to sense a physical event directly without the use of the usual sense organs; and* precognition, *the ability to predict in advance how events will be, such as the order of cards in a deck before the deck is shuffled.*

Are these phenomena real, or are they simply chance occurrences? The answer to this question is quite controversial at the moment. Researchers in parapsychology believe they have demonstrated satisfactorily that such phenomena exist in some people. For example, one of the standard tests for ESP involves the use of 25 cards, each with one of five different symbols (a star, a wavy line, a cross, a square, or a circle). The chances of being correct in guessing which card is next (or which one a person is looking at) are 1:5, or 5:25. In other words, with no ESP ability, a person should guess 5 out of 25 correct, on the average. Some people, however, are able to get as many as 7 correct, and do so consistently. Such results are highly unlikely statistically, and thus the ESP researchers believe that such people demonstrate a capacity to perceive independently of the ordinary channels.

The scientific community, in particular, psychologists, have been reluctant to accept these findings. Actually, in recent years the controls applied to the ESP research studies have been quite stringent, and such findings would very easily convince even the hardest-headed scientist if they concerned some other phenomenon. However, it is extremely difficult to believe in the existence of phenomena that so clearly cannot be fitted into our overall conception of human behavior, which is basically a physicalistic and mechanistic one. Disbelievers point to the fact that negative results are seldom published, so that we do not know whether such "positive" findings are really positive or not. Also, there is the problem that ESP seems to be demonstrable only by investigators who already believe in it, and disbelief is sometimes taken as an explanation for negative findings. On the other hand, the same criticisms could be applied to scientific findings in general. Negative results are seldom published, and so we really have little knowledge of the generality of many "well-established" phenomena. Also, most scientific investigators are not really emotionally neutral about the events they are investigating, and it is likely that preformed beliefs really enter the

picture here, too. It seems to boil down to the fact that scientists are willing to believe some kinds of results and not others, both sets of results being produced according to the same rigid criteria.

In recent years there seems to have been a softening in the approach to ESP by the scientific community. For instance, the Parapsychological Association, a professional organization of researchers and others interested in ESP and related phenomena, has recently been accepted into the American Association for the Advancement of Science. Also, at least two research grants have been awarded by the National Institutes of Mental Health for research in parapsychology. One of them concerns the possibilities of ESP's occurring during sleep, under the direction of Dr. Montague Ullman at the Maimonides Hospital in Brooklyn, New York. The other one concerned research on a machine to teach ESP (Wade, 1973).

There are numerous private foundations supporting research in parapsychology, and, what with the slowly increasing acceptance of this work by the scientific community, we may expect in the future to have more answers than are presently available. If human beings (and perhaps other animals) possess such abilities, then it is extremely important to know something about them. If ESP is in fact an artifact of the particular methods used to investigate it, then that is also quite important to know, because many of the same methods are used in other "establishment" areas, and one would then begin to wonder how many of the accepted scientific findings are also actually artifactual.

FILTERING

One way of looking at selective attention is in terms of a filter that "traps" unimportant signals. New, unusual, or important signals, however, can pass the filter. Thus, from the examples given, the unusual train and one's own name are heard. This reasoning implies that the filter must in some way be able to discriminate the meaning of the stimulus or else there would be no basis for the decision as to what is novel or important.

Selective attention has been studied in the laboratory in a number of ways. In one study Anne Triesman (1964) presented two different messages to the subject, one to each ear. One of the messages was designated as relevant and was to be repeated word for word by the subject as it occurred. (This procedure of repeating a message word for word is known as "shadowing.") The message in the other ear was irrelevant and was to be ignored. The properties of the irrelevant message were varied, however, in an attempt to see what kinds of things would be noticed by the subject, and how they would affect his ability to shadow the relevant message. When the two messages were in different voices, such as male and female, it was easy to ignore the irrelevant message. When they were in the same voice, however, shadowing was more difficult, indicating that the *physical* features of the messages enabled one of them to be rejected at a fairly early stage in the processing.

When the messages were in two different languages, but in the same

voice, shadowing was more difficult, although it was still possible. Interestingly enough, if the irrelevant message were a translation of the relevant one, many subjects would recognize the translation. The two-language task was easier when the two languages were phonetically different, indicating that the type of sounds characteristic of a language could be a basis for selection. This task was also easier when the subject was relatively unfamiliar with the second language. The most difficult task was when the second language was the same as the first, and in the same voice.

These results and others that have been accumulated more recently suggest that messages are analyzed in the nervous system in successive fashion, first on the basis of physical features, and later on the basis of syntax and meaning; even though the meaning of the rejected message may not reach awareness, its meaning is still processed in many cases.

WORD FREQUENCY

There is also evidence of visual selectivity. Much of this research has been done with a *tachistoscope*, which is a device for flashing stimuli for a very brief period of time. The subject's task is usually to describe the material presented. When words are flashed briefly, some kinds of words are recognized more easily than others. For instance, words that occur often in printed English are easier to recognize than rare words, partly because the verbal response that the subject has to give when he sees a word is more readily available in the case of frequently used words (Haber, 1965). Presumably, the availability of a response makes it more likely for a word to be processed up to the level of awareness.

PERCEPTUAL DEFENSE

Other evidence (extensively reviewed by Dixon, 1971) indicates that words evoking negative emotions (among the words used were "cancer" and some socially taboo words such as "penis," "whore," "cunt," and "shit") are not recognized as easily as neutral words, which are equivalent to the taboo words in other respects such as frequency, number of letters, etc. The meaning of such words is processed, even though the subject is not aware of their presence because of their being presented at either too brief an exposure duration or too low an intensity. The meaning may have quite a generalized effect, reducing the subject's sensitivity to other, neutral stimuli as well. For instance, presentation, at a level below awareness, of a taboo word to one eye will make it more difficult for the subject to see other neutral stimuli with the other eye.

These phenomena are collectively known as "perceptual defense," a concept that has been quite controversial in psychology ever since the experiment by Elliot McGinnies (1949) in which it was first demonstrated. The evidence seems reasonably good that the phenomenon exists, however, and it seems to be simply another case of selective attention (or, in this case, selective inattention).

Constancy

Size Constancy

The next time you are walking down the street, pay attention to the size of the objects you see as you walk toward them. Do they appear to change size, or do they appear to remain the same size? The answer depends partly on how far away you are when you start looking. If you are very far away, say, more than 1000 yards, the object may look quite small and then, as you approach it, its size increases up to a point. An airplane in the sky does not appear the same size as an airplane near you on the ground. On the other hand, if you are closer than about 1000 yards when you begin to notice, you will see that the object does not change size very much at all as you approach it. This phenomenon is known as size constancy, the tendency to see objects as having the same size in spite of relatively large changes in the size of the object as represented in the optic array. Obviously, in the naturalistic setting just described, knowledge about the object will play a major role in your judgment of how large it is. An adult male, for example, will usually be between 65 and 75 inches tall, and an automobile also has definite limits as to the sizes that it might be. Experiments, however, have been done with stimuli whose meaning does not denote a particular size, such as stakes of different heights driven into the ground at different distances from the observer, or circles of light, or cards of various sizes. These experiments have usually showed that, even in the absence of meaning, the observer tends to show size constancy as long as he has information about the distance of the object being judged. As information about *distance* is eliminated, however, size constancy deteriorates.

One explanation for size constancy, then, is that the observer somehow "takes into account" the distance of the object in judging its size. This "taking into account" has been expressed in terms of solving the equation,

$$\text{perceived size} = \text{retinal size} \times \text{distance}$$

Another explanation is that the observer learns to respond to those aspects of the optic array which specify the size of the object regardless of its distance. To return to the plate glass demonstration of Chapter 5 for a moment, it could be said that an object producing a picture of a given size at the bottom of the glass is seen as smaller than an object producing a picture of the same size halfway up the glass, at least as long as the texture gradient on the glass is that of a floor surface. This fact is illustrated in Figure 6.4. Thus the size of the object in the optic array in relation to its position on the texture gradient specifies its actual physical size. This explanation does not require the observer to make mathematical calculations, and thus makes it somewhat more plausible, especially since there is evidence that human infants as well as animals have the rudiments of size constancy. This matter will be discussed later.

Shape Constancy

Now look around the room again. If your desk is rectangular in shape, look at it, and then note that it *appears* for the most part to be rectangular. Now

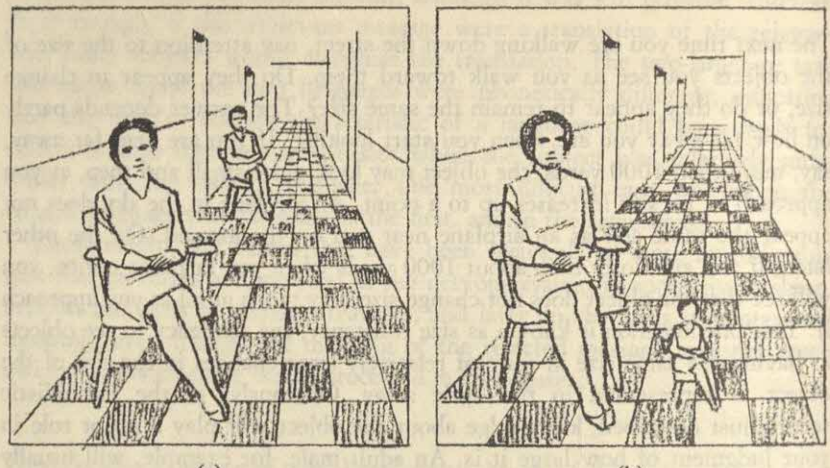


FIGURE 6.4 *Perceived size depends upon perceived distance. Notice in (a) how the woman in the background apears much larger than she does in (b), where she is shown at a nearer distance.*
From Boring, 1964.

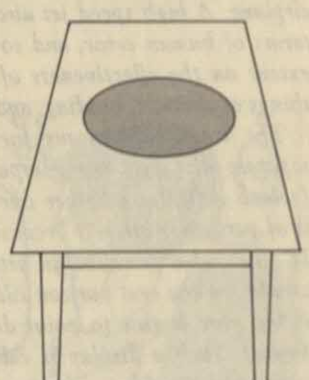
imagine what the shape would be if you drew it on the plate glass window. It would be trapezoidal. Similarly, although the dinner plate on the table looks and is round, its shape on the plate glass would be elliptical. The tendency to perceive objects as having a constant shape, regardless of the many different angles from which we view them, is called shape constancy. Shape constancy is in many ways similar to size constancy. Without information about the orientation in space of the object, there is no shape constancy. Thus, in Figure 6.5, the outline of the ellipse looks elliptical on the left but looks circular on the right, where it is presented as lying on a horizontal surface.

Color Constancy

Another constant aspect of the perception of objects is color. Snow appears white and coal appears black under a wide range of illuminations. A white piece of paper looks white in differently colored illuminations, including white sunlight, yellow incandescent light, and blue fluorescent light. As indicated in the previous chapter, perceived color, and color constancy, depend upon the presence of information about the illumination of the surround.

You may have been thinking that perhaps the constancies are caused by particular attitudes on the part of the observer. For instance, it may be that people somehow learn to "correct" perceived size for variations in distance and to "correct" perceived brightness for variations in background illumination. To a certain extent this is probably true, at least for size and shape constancy. If an observer is instructed to make his size or shape judgments as accurately as possible, and is informed, or reminded, that he ought to

(a)



(b)

FIGURE 6.5 *Shape constancy. The ellipse shown in (a) is the same as that shown on the table in (b), although the one in (b) looks more nearly round.*

take into account the varying distances or orientations, he will sometimes exhibit what is called overconstancy. He overcorrects so that, for example, an object at a great distance is judged to be larger than it really is. On the other hand, if the observer is told to make his judgments simply on the basis of the "appearance" of the objects, without regard to actual size or shape, constancy turns out to be somewhat less (although it is still present). Thus size and shape constancy are partly determined by whether the observer is trying to judge accurately or simply on the basis of appearances.

Lightness constancy, however, is not so easily manipulated by instructions to the observer. The only way that a piece of black paper in bright sunlight can be made to look white is to obscure completely the observer's view of the surround. When the surround is not seen, then perceived brightness varies with the amount of illumination. As soon as the surround becomes visible, the perceived brightness of the object *immediately* changes to that specified by its relationship to the surround. The process is quite automatic and is quite surprising the first time it is seen. The same thing can be said for the perception of hue. Object hue is affected by the hue of the illumination as long as the surround is not visible. As soon as the surround becomes visible, then the hue specified by the relationship to the surround is the one seen.

You may demonstrate these phenomena to yourself by looking at, say, a

Visual Information Display

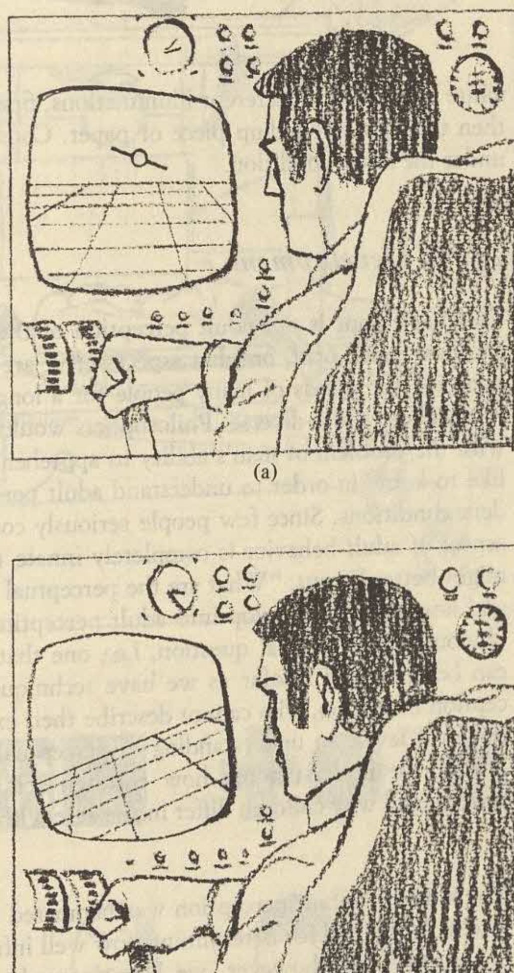
Man is highly dependent upon vision for the guidance of much of his behavior, and many modern technological developments depend for their effectiveness on the vision of a human operator. Consider, for example, the airplane. A high speed jet aircraft does not permit a great deal of leeway in terms of human error, and so its performance and safety depend to a great extent on the effectiveness of the visual display of information about such things as altitude, heading, and attitude.

The traditional means for displaying such information involves three separate displays: the compass, the altimeter, and the attitude indicator (which indicates whether one is flying level or not). The attitude indicator is of particular interest because of the way the traditional instrument works. It gives what is called an artificial horizon that tilts in the same way you would see the real horizon tilt if the plane began to roll. The indicator rises if the nose begins to point down, and falls if the nose points up (see the figure). Such a display is called an "inside-out" display because it shows what you would see happening to the horizon from inside the airplane. According to some human factors engineers, the inside-out display is not the best way to display attitude information, because corrective movements must be made in the direction opposite to what appears to be the natural way. Thus if the artificial horizon rolls clockwise, the appropriate control action would be to roll the plane clockwise, rather than to make the opposite, more natural motion of correcting in the opposite direction.

A more suitable arrangement is the "outside-in" display, which displays the actual attitude of the plane, as though you were looking at it from the outside. Thus a roll clockwise would be indicated by a clockwise movement of a line indicating the airplane itself (i.e., rather than the horizon, which is displayed as stable), and corrected by a control action in the opposite direction.

In spite of the fact that research studies have shown the ouside in display to be superior to the inside-out, in the sense that corrective movements are more readily and accurately made with the latter, actual aircraft still use the inside-out display, and for a very good reason. All pilots have been trained on that display, and shifting in midstream, so to speak, could be disastrous. Suppose that you were in a perilous situation and your life depended upon making the correct movement. It is possible that if you had learned to fly with one type of display but were shifted to one opposite in character, you would more or less automatically make the wrong movement. Thus this is a situation in which tradition takes precedence over a psychologically better arrangement.

In recent years there has been a great deal of interest in providing so-called integrated displays, in which attitude, altitude, and heading information are all presented on the same display, and in a manner that is analogous



(a)

(b)

(a) Outside-in display of aircraft attitude; (b) inside-out display of aircraft attitude.

to what you would see visually. Such a display is called a "contact analog" display, since the information it presents is analogous to what you would get from direct visual contact. The display is usually generated by a computer and presented on a television screen, as indicated in the figure. Perspective information and blur which simulate the information on the imaginary "plate glass window" referred to in the chapter, can be used to great advantage in this type of display. Contact analog displays may be of the outside in or the inside out variety, as you can see. As in the case of the traditional displays, the outside-in display yields better performance than the inside out. (Matheny, Dougherty, & William, 1963.)

white paper in two different illuminations, first under normal conditions and then through a rolled-up piece of paper. Constancy will be sharply reduced under the latter condition.

Perceptual Learning and Development

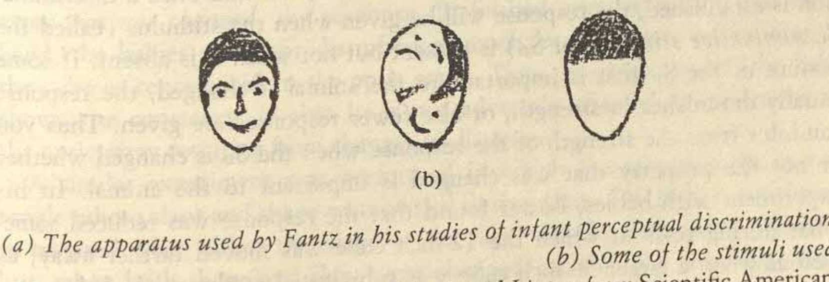
To what extent is our adult perception of the world a product of learning, and how much of it, or what aspects of it, are unlearned? This question has occupied the minds of many people for a long time. The reasons for asking it have been quite diverse. Philosophers would like to know in order to deal with the problem of man's ability to apprehend reality. Psychologists would like to know in order to understand adult perception in terms of its antecedent conditions. Since few people seriously consider the possibility that any aspect of adult behavior is completely innate (see Chapter 3), the question might better be put, "What are the perceptual capacities of newborn infants, and how do they develop into adult perception?" When put this way, it is obviously an empirical question, i.e., one that can be answered. At least it can be answered insofar as we have techniques available for studying perception in infants, who cannot describe their experiences verbally. At a more practical level, an understanding of perceptual learning and development is critical for understanding how children acquire such perceptual skills as reading and why children differ in the ease with which they can do so.

Infant Capacities

The study of infant perception was hampered for many years by the lack of a reliable method for determining how well infants can perform perceptually. In recent years, however, we have learned a good deal about infants by studying, first of all, *natural reactions* such as their patterns of eye movements in response to various kinds of visual stimuli. Second, other investigators have applied *operant conditioning procedures* (see Chapter 7) to the study of perception in human infants in much the same way that these procedures have been applied to perceptual processes in animals.

The psychologist R. L. Fantz (1961) developed a method for studying the visual preferences of newborn infants. The baby is observed through a peephole in a box, which is placed over its crib (Figure 6.6). Targets such as a bulls-eye, a checkerboard pattern, geometrical figures, representations

(a)



(b)

FIGURE 6.6

(a) The apparatus used by Fantz in his studies of infant perceptual discrimination. (b) Some of the stimuli used.

From Fantz, 1961, photograph by David Linton from Scientific American.

of a human face, etc., were presented two at a time, and the experimenter observed the baby to see which target he looked at and for how long. Some of the pairs produced preferences, in that the baby would look at one object longer than the other. Since he would have to be able to discriminate the patterns in order to show a preference for one of them, a preference for a given pattern that occurs, regardless of whether it was on the left or the right, indicates that he can discriminate the two patterns. This is an important finding, because before that time it was uncertain just how much pattern vision newborn babies have. Other observations reveal that the youngest infants seem to be "captured" by the stimulus, as though they could not turn their gaze away. Later the ability to select patterns and to look from one to another voluntarily develops.

One visual response that has been of particular interest is responding to a human face or to a picture of one. The response is usually to stare or to smile at the face. This behavior has particular social significance, in view of the reaction it usually evokes in the parents of the child. It is not present in newborn infants, although they will spend more time looking at complex, as opposed to simple, circular stimuli. The smiling response does not begin until about 6 weeks of age. At that time, however, infants smile not only at faces, but also at other stimuli such as dot patterns. Thus the first response is generalized; i.e., it occurs in a wide variety of stimuli. At about 2 months the arrangement of the eyes becomes important, and a circle containing dots with eyebrows will produce a stronger response than one without the eyebrows. By 3 months of age even more realistic versions are preferred. By 5 months the mouth begins to be noticed; then movements of the mouth become more effective, and three-dimensional faces are preferred over two-dimensional patterns. After this time living faces are fairly readily discriminated (and preferred) from nonliving dummies. In general, the infant seems to develop the ability to discriminate finer and finer aspects of the optic array corresponding to the face and, finally, will accept only a real face.

Other recent experiments have shown that infants possess a significant degree of size and shape constancy. T. G. R. Bower (1966) made this demonstration in the following way. First of all, he trained infants as young as 36 days old to turn their heads to the left when a 12-inch cube was present on the table in front of them, and not to respond when the cube was absent (see Figure 6.7). This is a form of discrimination training (Chapter 7). Experiments with animals have shown that once a discrimination is established, the response will be given when the stimulus (called the *discriminative stimulus*, or S_D) is present but not when it is absent. If some feature of the S_D that is important to the animal is changed, the response usually diminishes in strength, or else fewer responses are given. Thus you can infer from the strength of the response when the S_D is changed whether or not the property that was changed is important to the animal. In his experiment with babies, Bower found that the response was reduced somewhat during tests in which the 12-inch cube was moved farther away, as well as when a larger 36-inch cube was substituted at the original distance.

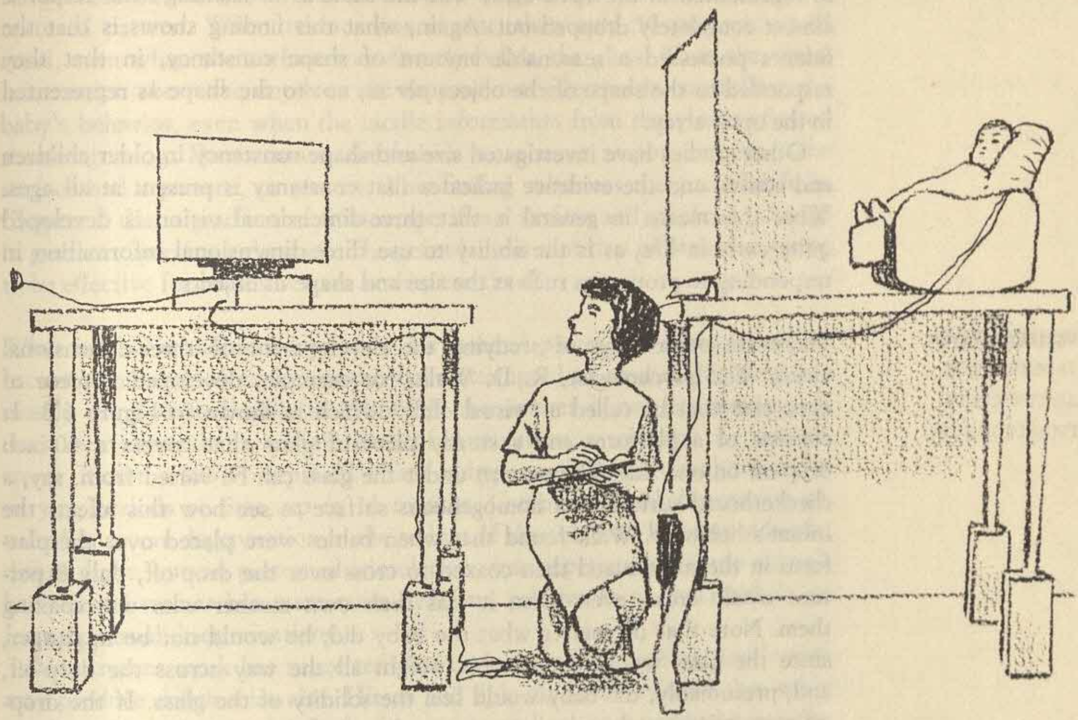


FIGURE 6.7

The experimental situation used by T. G. R. Bower in his studies of constancy in infants. The baby is reinforced by the experimenter (who jumps up and goes "peek-a-boo") when he turns his head to the left in the presence of the stimulus. In this case the stimulus is a rectangular board oriented at 45 degrees to the baby's line of sight. In other experiments a 12-inch cube was used as the stimulus. From Bower, 1966. Photograph by Sol Mednick from Scientific American.

However, when the larger cube was placed at the farther distance so that *the size of the cube as represented in the optic array was the same as that for the smaller cube at the nearer distance* (i.e., the one used in training), the response almost completely disappeared. What this finding means is that the baby was responding to both the size and distance of the cube. When either of these features was changed, the response diminished. When both features were changed in such a way that the size of the cube in the optic array was *not changed*, the response diminished even more. On the other hand, the babies were not disturbed as much by variations in the size of the cube as represented in the optic array. Thus, you may reason, the baby shows size constancy, in that he is not adversely affected by variations in the optic array resulting from changes in distance.

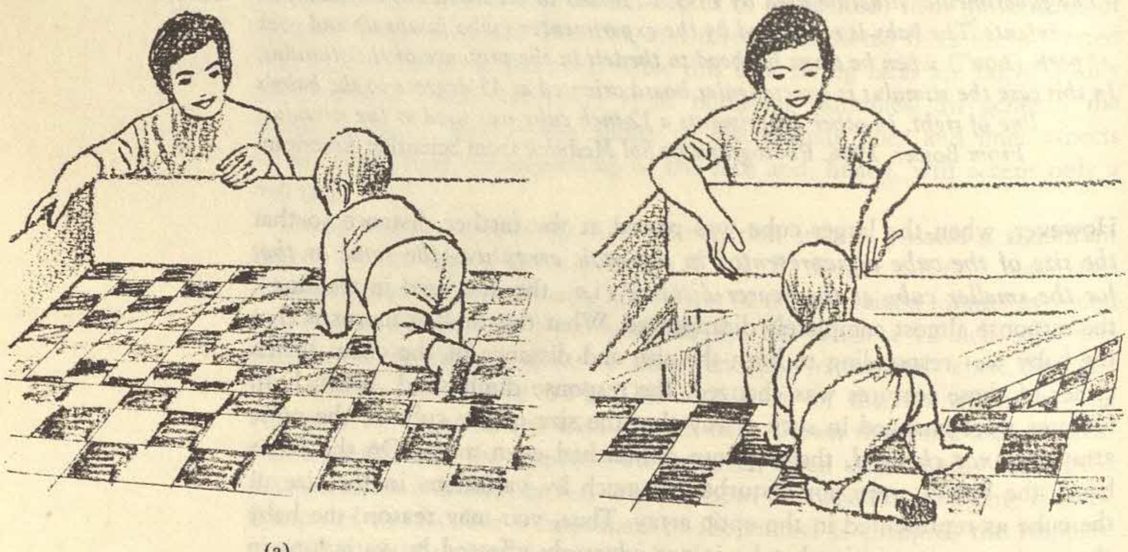
A similar experiment was performed in which the stimulus was a rectangle whose slant and shape were varied during tests. The infants continued to respond when either the shape or the slant was the same as in training, but, when both shape and slant were changed (so that the resulting shape

as represented in the optic array was the same as in training) the response almost completely dropped out. Again, what this finding shows is that the infants possessed a reasonable amount of shape constancy, in that they responded to the shape of the object *per se*, not to the shape as represented in the optic array.

Other studies have investigated size and shape constancy in older children and adults, and the evidence indicates that constancy is present at all ages. What this means in general is that three-dimensional vision is developed quite early in life, as is the ability to use three-dimensional information in responding to properties such as the size and shape of objects.

VISUAL CLIFF

There are other ways of studying the development of three-dimensional vision. The psychologist, R. D. Walk, for example, developed a piece of apparatus that he called a "visual cliff," which is shown in Figure 6.8. It consists of a platform and a sturdy piece of glass that covers a 40-inch drop-off on one side. The pattern under the glass can be varied from, say, a checkerboard surface to a homogeneous surface to see how this affects the infant's behavior. Walk found that when babies were placed over the platform in the middle and then coaxed to cross over the drop-off, only 8 percent would cross, even when it was their own mother who was coaxing them. Note that no matter what the baby did, he would not be in danger, since the glass would support his weight all the way across the drop-off, and, presumably, the baby would feel the solidity of the glass. If the drop-off were raised so that the pattern was directly below the glass, then almost



(a) (b)

FIGURE 6.8 *The visual cliff. (a) The infant, placed on the center portion by its mother, readily crawls over the shallow side of the "cliff" when she calls. (b) However, when he is called to come across the deep side, he refuses to come even though he can feel, by patting the glass, that it is "safe."*
Photography by William Vandivert from Scientific American.

90 percent of the babies would cross as long as the surface contained a textured pattern. When texture was absent, then only 50 percent would cross, even when the surface was directly below the glass. Thus the visual information about the depth of the drop-off was effective in controlling the baby's behavior, even when the tactile information from the glass indicated a safe crossing. Furthermore, the babies were most responsive when the surface had a pattern, or texture. This finding reiterates the point made in Chapter 5 that a gradient of texture specifies a surface and an abrupt change in gradient specifies a drop-off. The point here is that this information seems to be effective for babies as soon as they can crawl.

REQUIREMENT FOR NORMAL PERCEPTUAL DEVELOPMENT

What are the conditions necessary for normal perceptual development to occur? A number of experimenters have attempted to answer this question, mostly using animal subjects. Although the answer is not yet clear-cut, it does seem clear that a certain level of stimulation is required. At one extreme Riesen (1958) deprived infant chimpanzees of all visual input for varying periods of time, up to 16 months. Complete visual deprivation resulted in severe degeneration in the retinas of the subjects. In other subjects, diffuse light, but no patterned stimulation, was experienced. These animals had normal retinas but were quite deficient, relative to normal animals, in learning visual discriminations.

More recent work has suggested that certain kinds of pattern deprivation may produce deficiencies also. Hirsch and Spinelli (1970) found that when newborn kittens were deprived of exposure to lines in a particular orientation (e.g., to horizontal lines), neurons in their visual systems became insensitive to lines in that orientation but not in other orientations.

There is also evidence that normal development requires that the infant move actively in his visual environment. According to Held and Hein (1963), kittens who received only passive visual stimulation were deficient in some perceptual tasks such as avoiding the visual cliff when compared with subjects receiving an equivalent amount of actively induced visual stimulation.

Later Trends

DIFFERENTIATION

It should be clear from the above discussion that human infants have rather well-developed visual capacities. What, then, accounts for the obvious difference between infants and older children or adults? Much remains to be learned about this field. It is fairly certain, however, that one important thing the child learns is to respond to more and more distinctive and finely differentiated features of the world. Increased differentiation is also seen in the development of the response to faces described above, in that at first any of a number of stimuli will evoke the response but later only a three-dimensional face will do. The baby learns not only to make finer and finer discriminations (e.g., between his mother and other people), but also begins to become more and more particular as to what objects he will accept as a face. Finally, only the unique pattern of relationships in the optic array that actually correspond to a face will do. The same rules seem to hold for later

development: the child learns more and more of the distinctive features of the world to which the adult responds.

COMPLEXITY

A second developmental trend involves learning to respond to more complex relationships, or, in other words, to respond to larger units of stimulation. In learning to read using phonics, for example, the child must first learn to discriminate the different letters of the alphabet, i.e., to respond to more and more distinctive features, such as the difference between a "d" and a "b," or an "m" and a "w." Next he must learn to combine the letters into sounds, which involves putting the units together in different ways to produce different results (sounds). Finally, sounds as represented graphically by letters are combined into words. In other words the process is one of putting together more and more complex combinations of the basic units. Later, the good reader learns to read phrases, or combinations of words, rather than individual words. He also learns to take advantage of the redundancy that is characteristic of language. He does not have to read every word in order to appreciate the meaning of a passage.

SENSORY INTEGRATION

A third trend in perceptual development involves the establishment of better integration between the various sense systems. Most objects stimulate more than one sense, and eventually they can be recognized by several systems. A previously seen object may, for instance, be recognized by touch alone, and *vice versa.* Sounds, feels, smells, etc., become integrated into the total conception of an object. In the development of this equivalence between senses, it is now clear that the dominant sense is at first vision. Humans are highly visual creatures, and the recent evidence that has been gathered indicates that the visual information-gathering capabilities develop before the others. A child will, for example, grasp at a visually presented object before he will attempt to explore the object tactually (Bower, 1970). Later, however, active tactile exploration develops and provides an additional information channel to supplement the visual information. On this basis the complex representations of objects characteristic of the adult develop.

The Motivation of Perception

THE MOTIVE TO PERCEIVE

It should be obvious that an animal without any sensory or perceptual apparatus would not survive very long because it would have no means of remaining in contact with its environment and would certainly be unable to perform the minimal tasks necessary for survival, such as getting food, avoiding dangerous situations, etc. You have also seen that a certain level of stimulation is necessary for normal development. Deprivation has adverse consequences, and it would appear that to perceive is a necessary part of life. You will see later (Chapters 12 and 13), when we begin the study of motivation, that a great deal of behavior, particularly behavior that is survival-oriented, is highly motivated. In other words, there is a strong drive to perform those behaviors that preserve life and the species.

Substituting Touch for Vision in the Blind

The strong dependence of the human being on vision becomes a particularly serious matter for someone who is visually impaired. Over the years various attempts have been made to provide partial alleviation of the impairment by using another sense, such as hearing or touch. The most successful of these attempts has been the Braille system, which is used for reading. Reception of information from stimuli at a distance, however, has depended upon the use of sounds reflected from objects. The blind person's cane produces sounds which, once they are reflected off of objects, provide information as to their distance and, to a certain extent, their size (Kellogg, 1962).

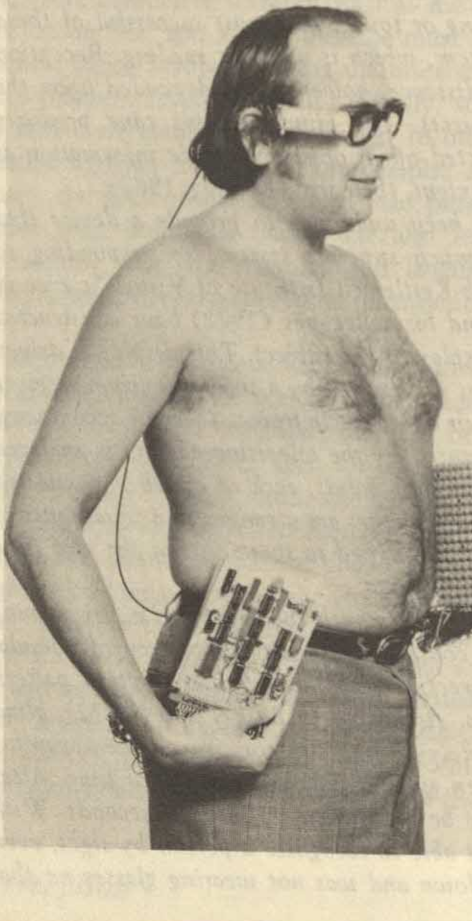
In recent years a program has been underway to provide a device that would give the blind person a much superior system for responding to objects at a distance. At the Smith-Kettlewell Institute of Visual Science in San Francisco, Paul Bach-y-Rita and his colleagues (1972) have constructed a device that presents a tactual display to the subject. This display is driven by a complex electronic system that is activated by a small television receiver which the subject can wear on a pair of spectacle frames (see the accompanying figure). The optical image captured by the television camera is analyzed electronically into a matrix of up to 400 points, each of which is connected to a tactile stimulator. The tactile stimulators are arranged in a square matrix with the same number of points and strapped to some area of the skin. The forehead, chest, and back have all been used.

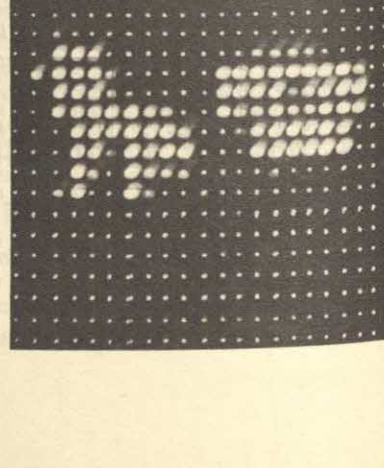
When the subject scans a set of objects with the camera (i.e., by moving his head around), the result is a continuously changing pattern of stimulation on the skin which bears a direct correspondence to the optical pattern captured by the television camera. According to Bach-y-Rita (1972), blind subjects who have had approximately 15 hours of training on the apparatus can recognize familiar objects when given a sufficient amount of time. After some practice, simple objects can be recognized in 5 to 20 seconds. With extended practice one subject was able to recognize a person by sight, even to noting that she had her hair down and was not wearing glasses on that occasion.

It is quite interesting that practiced subjects came to experience the objects that they "saw" as being located "out there" in space. In other words, they were not so much aware of being touched by the apparatus as they were aware of the properties of the objects that they perceived at a distance. (Obviously, if they focused their attention on their skin, they were aware of being touched. However, the "projection" of the experience into so-called extrapersonal space is of extreme importance.)

The work with this system is important on several counts. First of all, it is likely that a workable aid to the blind will come from it. The results are certainly encouraging in this respect. Second, the fact that vision and

touch can both provide the basis for the perception of objects at a distance is of great theoretical importance. It has been known for some time that, anatomically, the two systems have much in common. This work suggests still other commonalities.





TO PERCEIVE IS REWARDING

Perceiving provides a major part of the information on which such behaviors are based, so it is to be expected that there would be a strong motive to perceive, or to gather information. There is a large number of experiments demonstrating this fact. For example, Montgomery and Segall (1955) showed that rats, if given the choice between two pathways, one of which leads to an empty goal box and the other to a set of compartments through which the animal can run, will choose the compartments rather than the empty box. The incentive is presumably the additional stimulation provided. Other experiments (e.g., Dember, 1956) have shown that if rats are first allowed to explore a maze with two different goal boxes, one black and one white, and then one of the boxes is changed on the next trial, they will enter the one that was changed rather than the constant box. The incentive is presumably the difference in stimulation provided, or, perhaps, the difference in information provided by the two boxes. Butler (1953) showed that monkeys would solve discrimination problems, i.e., learn to choose the correct stimulus, when the only reward for correct performance was to be allowed to look through a small door into a room containing some interesting objects, such as another monkey or a toy train running on a track. Friedlander (1962) has conducted similar experiments with human children, who would work in order to be allowed to look at pictures. Furthermore, as you might expect, they would work harder for a cartoon than for a rather uninteresting white spot of light.

EFFECT OF DEPRIVATION

If animals, including humans, will work in order to receive stimulation or the opportunity to perceive, what would happen in a situation in which they were *deprived* of stimulation? A number of such experiments has been performed in which humans were subjected to so-called sensory deprivation. In one of the first such experiments (Bexton, Heron, & Scott, 1954) college students were invited to spend as long as they wished in a special room and were paid $20 per day for their time. The situation is illustrated in Figure 6.9. Translucent goggles admitted light but prevented pattern vision; cuffs on the arms and legs prevented most movements; "white" noise (which sounds much like a radiator hissing steam) was played in the room to mask out sounds. In general, perceptual activity was drastically reduced except for the carrying out of such necessary functions as eating and going to the bathroom. You might think that overworked college students would jump at the chance to earn money for doing nothing and would use the experiment to get a week's vacation with pay or to catch up on their thinking. What actually happened was that many of the subjects were unable to continue the experience for more than a few hours. The deprivation was very unpleasant for some of them, partly because of the occurrence of hallucinations. They found that they were unable to carry out the thinking that they had planned. There were other effects as well. For example, at certain times during the deprivation the experimenters gave the subjects tasks to perform (e.g., arithmetic problems, etc.). Performance was generally low. Immediately after the experience, perceptual distortions such as apparent movement (seeing things move when they were not really moving), en-

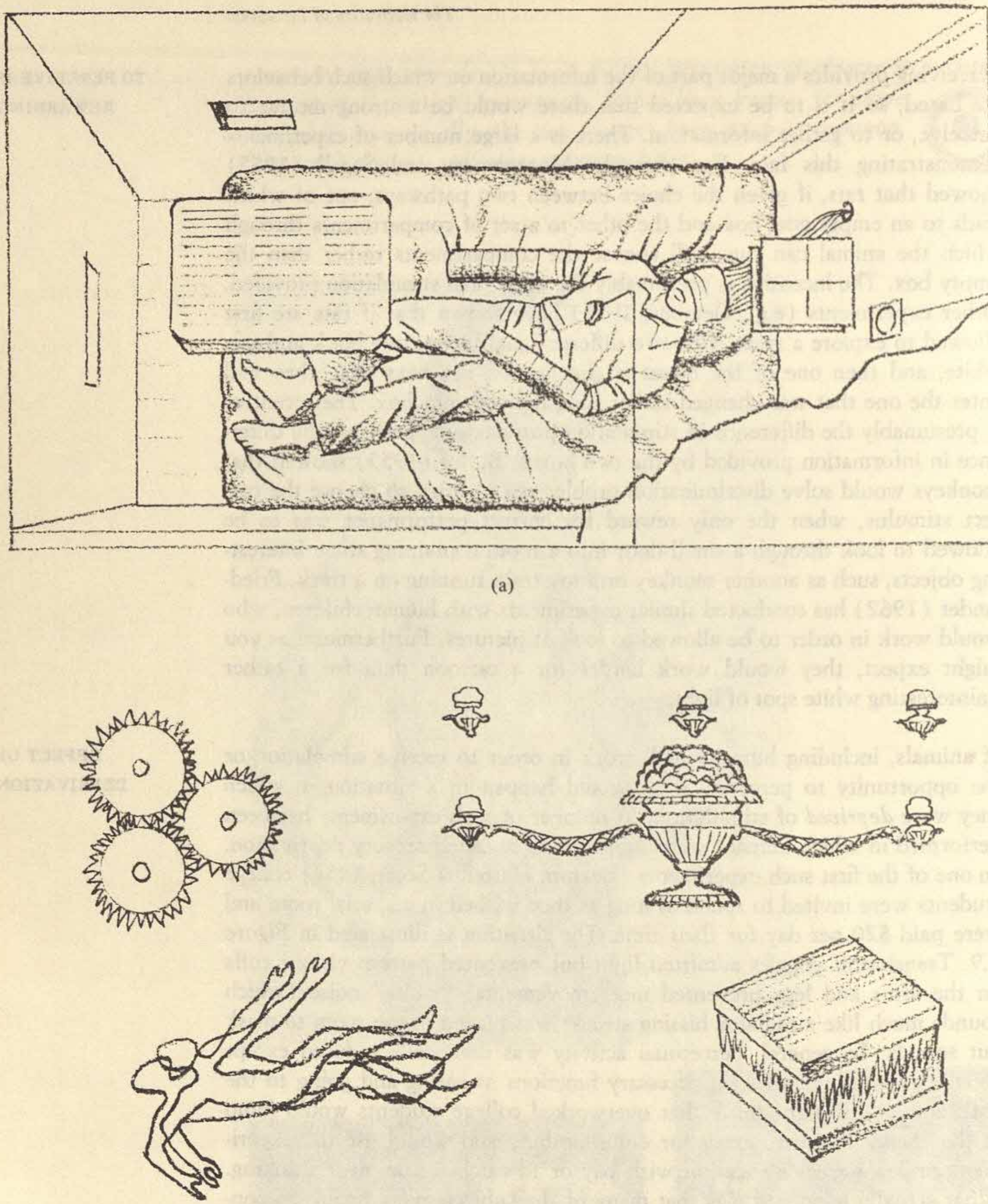


FIGURE 6.9 *Sensory deprivation. (a) The experimental cubicle used by Heron and others. (b) Some of the hallucinations reported by subjects in this situation, based upon their descriptions after the experience. More recent studies have reported fewer hallucinations, perhaps because earlier studies suggested to the subjects that they might hallucinate.*
From Heron, 1957.

hanced saturation of colors, and shape distortions were reported. While there were many other aspects of the experience that are worth describing, the main point is that it underlines the motivated nature of perception and the fact that *normal mental functioning requires a certain level of sensory input.*

Nonveridical Perception

Illusions

To one who is a strong advocate of the old notion that "seeing is believing," the existence of illusions must present somewhat of a problem. Although our perceptual experience can usually be counted on to come up with a correct account of the world "out there," there are special situations in which experience is systematically distorted, and what is seen is not actually what is "there." Such phenomena are called illusions, and many of the more common illusions are quite familiar. Some of them are shown in Figure 6.10.

Why are illusions important, and how can they be explained? In the first place, it is the existence of illusions that provides part of the basis for the idea that the study of perception constitutes a problem at all. Consider the basic question: "Why do things appear the way they do?" This question has provided the starting point for a number of investigators of perception, notably the Gestalt psychologists. Suppose that you answer, "Because they are what they are." Although major questions about how information from the world is transformed into experience are left unanswered by the above reply, the idea that perceptual experience is a completely accurate representation of the world (a philosophy kown as *naïve realism*) has in the past led to some strange theories of perception. For example, one theory postulated that somehow "copies" of the object are transmitted to the brain, where they are seen; a modern version of this theory assumes that we can recognize patterns because the pattern of excitations conducted from the retina to the brain bears some resemblance to the object itself. The existence of illusions—perceptual experiences not directly predictable from knowledge of the object perceived—suggests the inadequacy of such simplistic explanations and forces us to investigate further.

Many psychologists now agree that illusions result from the operation of the same processes that underlie veridical perception. They are not special phenomena but only special cases of normal phenomena. A recent treatment of the illusions by R. H. Day (1972) makes this point clear. He points out that in "real life," which is three-dimensional, many aspects of the stimulus as represented at the receptor (i.e., the optic array) support the constancy of perception, which we have already discussed. Consider Figure 6.11. In (a) the two block "men" appear to be the same size. Since there are more elements of texture per unit area in the upper portion of the figure than in the lower, the smaller figure masks an equivalent amount of texture as the larger one. In (b), with all information about distance except elevation in the picture plane gone, the upper figure looks smaller than the lower one. In (c), where the two figures are physically equal, the upper one masks more

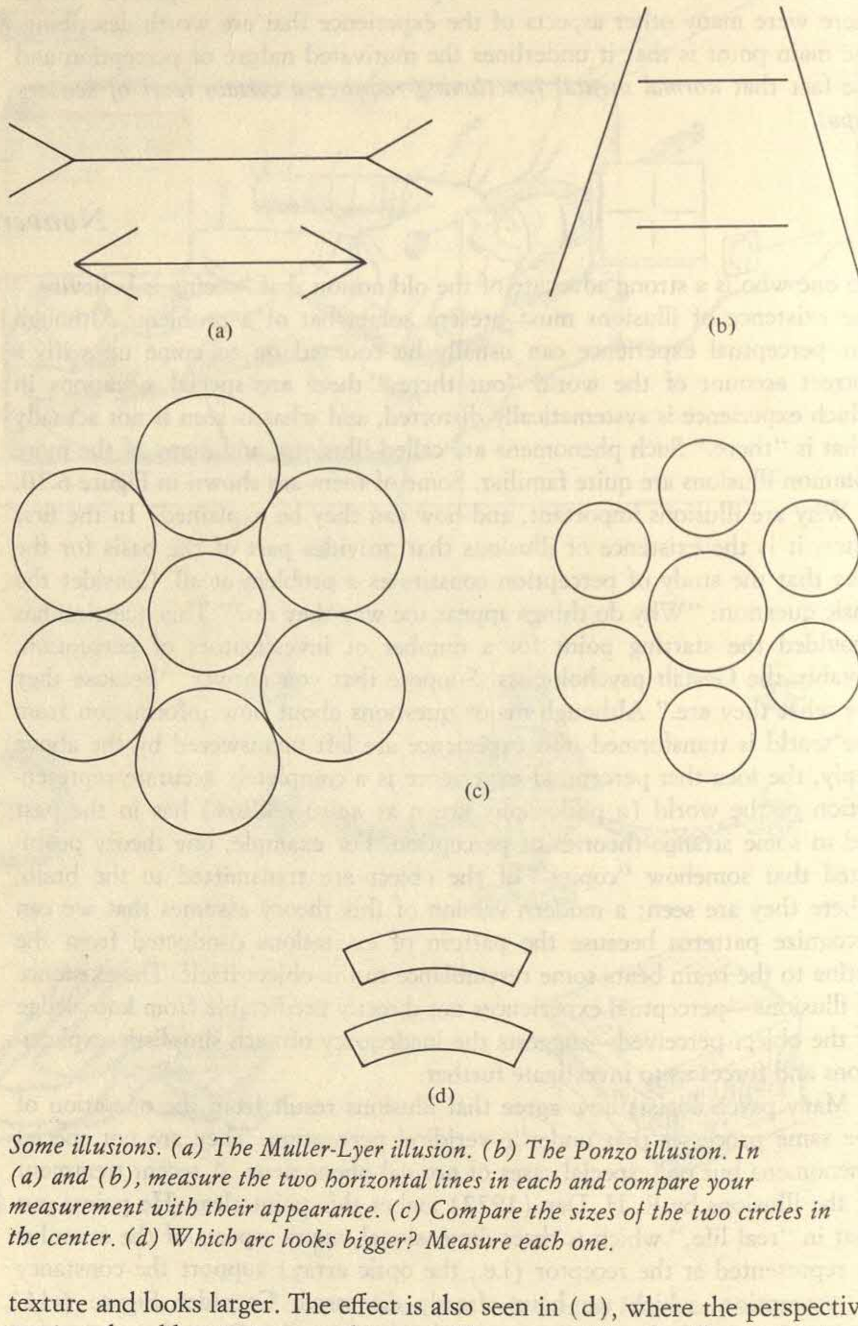


FIGURE 6.10 *Some illusions. (a) The Muller-Lyer illusion. (b) The Ponzo illusion. In (a) and (b), measure the two horizontal lines in each and compare your measurement with their appearance. (c) Compare the sizes of the two circles in the center. (d) Which arc looks bigger? Measure each one.*

texture and looks larger. The effect is also seen in (d), where the perspective cue is reduced but texture masking is still present. (See also Figure 6.4.)

The Ponzo illusion [(Figure 6.10)(b)] is a special case of the same effect except that proximity of the horizontal lines to elements representing different distances seems to account for it. In general, a given object bounded by a large object (which would appear nearer because of its size) would appear

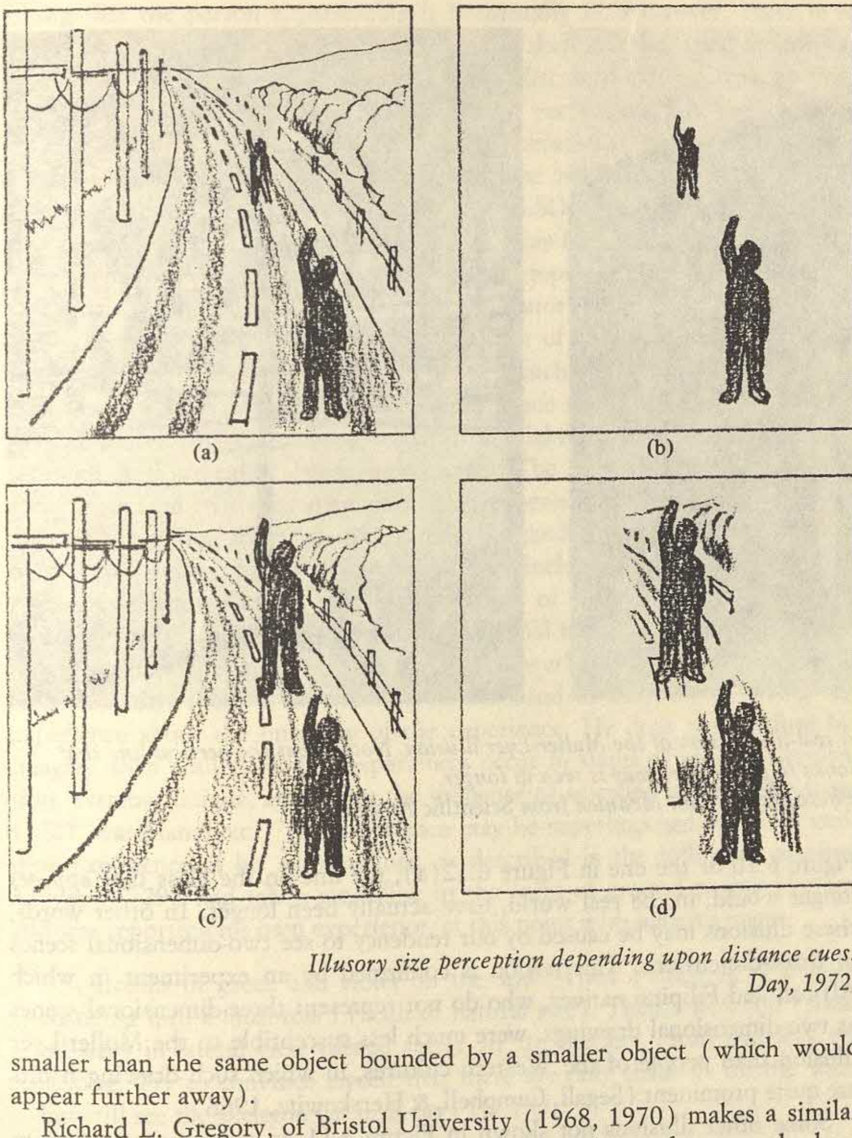


FIGURE 6.11 *Illusory size perception depending upon distance cues.* *Day, 1972.*

smaller than the same object bounded by a smaller object (which would appear further away).

Richard L. Gregory, of Bristol University (1968, 1970) makes a similar point with respect to the Muller-Lyer illusion. He shows, for example, how the Muller-Lyer illusion is perhaps caused by our tendency to see figures containing oblique lines as three-dimensional (see Figure 6.12). Gregory suggests that the reason the line bounded by the "arrowheads" looks shorter is that, when seen in three dimensions, it looks nearer than the other line. The same reasoning might well apply to the Ponzo illusion. In both cases Gregory assumes that the brain makes an inference about the nature of the stimulus. However, because the inference is based on incomplete data (i.e., a two-dimensional *representation* of three dimensions rather than an actual three-dimensional scene), it is incorrect. Recall the plate-glass window demonstration discussed in Chapter 5. For either scene, the one shown in

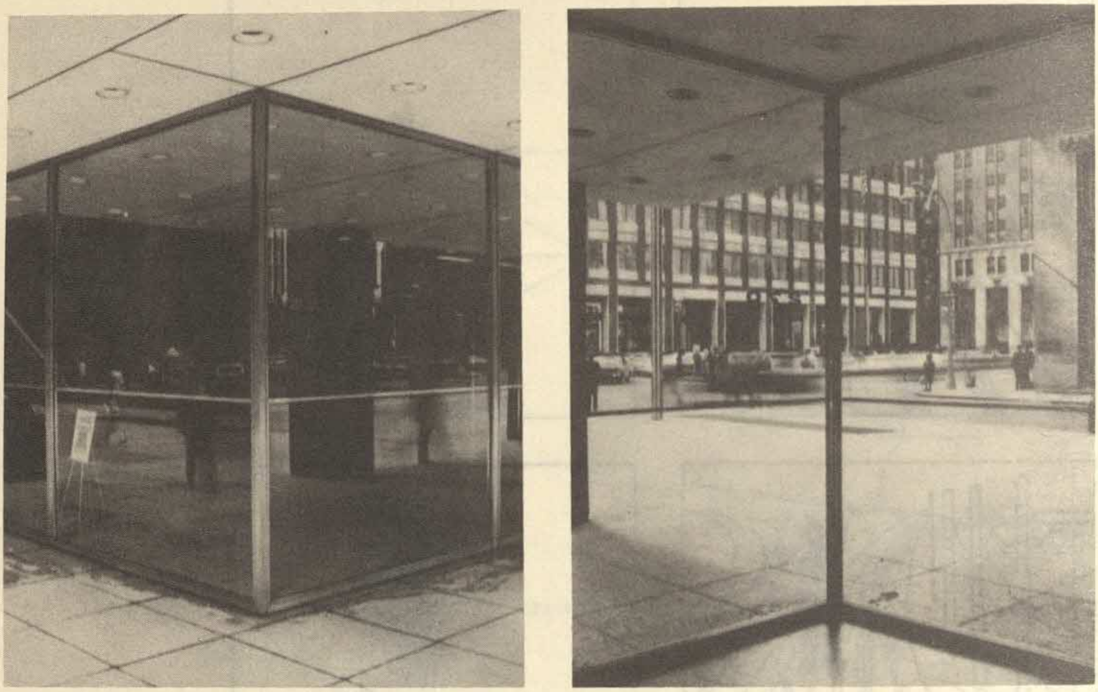


FIGURE 6.12 *A real-life version of the Muller-Lyer illusion. Notice that the vertical line that looks to be farther away is seen as longer.*
Photograph by Sol Mednick from Scientific American.

Figure 6.10 or the one in Figure 6.12(a), the line on the glass that *appears* longer would, in the real world, have actually been longer. In other words, these illusions may be caused by our tendency to see two-dimensional scenes in three-dimensions. This notion is confirmed by an experiment in which African and Filipino natives, who do not represent three-dimensional scenes as two-dimensional drawings, were much less susceptible to the Muller-Lyer illusion than people of the Western cultures, in which such drawing habits are quite prominent (Segall, Campbell, & Herskowitz, 1966).

Some other illusions not shown in Figure 6.11 do not appear to fit into the picture. Nevertheless, most investigators are convinced that illusions will ultimately be understood in terms of normal, everyday perceptual processes which, because of the special way in which the figures are presented, yield an incorrect experience.

Hallucinations

While illusions may represent the operation of normal perceptual processes in special circumstances so that an inaccurate experience is obtained, there are also occasions in which one has experiences of a perceptual nature for which there is *no* obvious external stimulus. There is a wide variety of such experiences, and the term "hallucination" is perhaps not the best one to use because it immediately implies a bizarre, abnormal phenomenon usually indi-

cating that the person experiencing it is mentally ill. However, there is at present no other single term available, so we shall use the word guardedly, keeping in mind that much of what is to be discussed can occur in normal, as well as mentally ill individuals. In recent years there has been a great deal of interest in these phenomena, partly because of their occurrence in states of sensory deprivation and partly because many of them are produced in normal individuals by certain drugs, such as LSD, mescaline, and marijuana. Also, you will recall, psychology has veered away from extreme behaviorism, which ruled out subjective phenomena as valid topics for study.

There are several ways in which hallucinatory phenomena vary. First, there is the matter of *content*, or the character of the experience. Some hallucinatory experiences may be quite simple, such as flashes of light, spots, and other vague nonmeaningful sensations. Such experiences often occur in normal individuals upon going to sleep at night or on waking up in the morning, and are called *hypnagogic images*. The experiences are not necessarily visual, in that they may involve an experience of movement, such as floating through space or simple sounds. Somewhat more complex imagery may occur under the same circumstances, including geometric patterns, cobweblike forms, and nonvisual distortions of perception of one's body (e.g., a very large head). Some perfectly normal individuals with very vivid imagery may experience brightly colored flowerlike forms upon going to sleep. Usually, there is no question in the mind of the person having the experience about the unreality of the experience. He does not confuse his imagery with reality. Similar experiences occur in states of sensory deprivation, extreme fatigue, and under the influence of so-called psychedelic drugs (LSD, marijuana, etc.) The experience may be superimposed upon his veridical experience of his surroundings, as described in the following passage. Kluver (1929) had taken mescaline in the form of ground peyote buttons and was reporting his own experience, at this point with his eyes open:

> . . . streaks of green and violet on the wall. Then a drawing of a head changing into a mushroom (both of natural size). Then a skeleton (natural size) in lateral view turned about 30° to the left. Head and legs are lacking. Try to convince myself that there are only shadows on the wall, but still see the skeleton (as in X-ray) (p. 18).

In general, although the person may become fascinated with the imagery, which often happens with psychedelic drugs, he usually does not confuse the real and the unreal.

More complex experiences may occur in sensory deprivation, under the influence of the psychedelic drugs, and in certain disease states, such as tumor of the temporal lobe of the brain. "An army of squirrels marching purposefully," reported one subject during sensory deprivation (Bexton, Heron, & Scott, 1954). The experience described in the next passage was reported by a patient with temporal lobe epilepsy just before going into a seizure:

> I saw this little man standing on my left. He was dressed all in gray with a cloak to match. He wore a beard and carried a cane. He just stood and

> looked at me without making a sound. I knew he wasn't there but he seemed very real (Baldwin, 1962, p. 77).

Another patient reported:

> I was walking up a gravel path towards a house and along a hedge. I had been there before. I could hear the gravel crunch under my feet and smell the cooking from the house. When I reached the porch, I blacked out. . . Each time I see myself doing this, I know I am going to have a spell (ibid., p. 77).

Again, there is usually insight on the part of the person having the experience that it is unreal and is not to be confused with experience of the real world. In the case of the patient with temporal lobe epilepsy, the experience may be repeated each time he has a seizure. Similar experiences are reported by patients undergoing brain surgery. Some of the reports obtained by Penfield and Roberts (1959) on stimulating the temporal lobes of patients included the following:

> As the current was started, a woman reported "Oh, a familiar memory—in an office somewhere. I could see the desks. I was there and someone was calling to me—a man leaning on a desk with a pencil in his hand (p. 45)."

In another case, a young man reported, "Yes, Doctor! Yes, Doctor! Now I hear people laughing—my friend—in South Africa (p. 50)."

In summary, hallucinatory experiences may vary from quite simple to quite complex, depending upon the circumstances. Another important way in which they vary concerns the perceived location of the experience. In the case of hypnagogic imagery, the experience is usually perceived as arising from within oneself. It may be quite vivid, but it is obviously internal in origin. Other experiences may be referred to the external world, such as the first two quotations above imply, although the subject is aware of their unreality.

The third way in which hallucinatory phenomena differ from one another is in terms of the belief on the part of the subject in their existence. In most of the circumstances described here there is little doubt on the part of the person that his experience is not real. On the other hand, one of the characteristics of hallucinations by psychotic patients is that the patient has difficulty distinguishing the hallucination from reality.

What causes hallucinations? The answer is that no one knows yet. Presumably hallucinations, like dreams, are caused by brain activity which is in some way similar to brain activity that occurs during veridical perception. In the case of temporal lobe epilepsy, it is possible that the experience is triggered by abnormal activity in brain cells that are involved in the storage of past experience. The same is probably true for the results of Penfield's work on brain stimulation. Why LSD, marijuana, sensory deprivation, and

fatigue should produce such experiences is at present anybody's guess. There was at one time a great deal of research on the physiological effects of LSD. However, about 1965, serious concern about the effects of this drug and the possibility of "bad trips," especially with inadequate supervision, has led to a decrease in research since then.

Summary

Perceptual experience results from the impingement of stimulus energies on receptors as well as from processes arising from inside the perceiver. Perceptions are usually organized into a figure, or focal stimulus, and the ground, or surround. Stimulus factors affecting the organization include proximity, similarity, continuation, good form, common fate, and closure. In some cases, notably so-called reversible figures, figure-ground relations are not stable but fluctuate from moment to moment. Subjects also exert active control over the process of organization, filtering out unmeaningful or unpleasant information before it reaches awareness.

Perceptual experience also exhibits constancy of size, shape, and color, in that what is perceived remains relatively constant in spite of large variations in the way the object is represented on the sense organs. These constancies depend upon the presence of information about the relationship between the object and its surround.

Perceptual learning and development has received much attention lately. Very young babies have been shown to have pattern vision, as well as depth perception and size and shape constancy. Normal perceptual development seems to require a certain level of stimulation. Given these basic capacities, later learning seems to involve learning to respond to more and better differentiated distinctive features of the environment, as well as to more complex stimulus relationships. Also, the various sense systems become better integrated with development.

Perception is also motivated. First of all, perceiving seems to be rewarding, in that animals will work in order to be allowed to experience new stimuli, and humans subjected to sensory and perceptual deprivation find the deprivation both aversive and disturbing in terms of the carrying out of normal perceptual activities and thinking.

Perceptual illusions demonstrate that the world is not always perceived accurately, and experiments with some of the illusions indicate that they are caused by normal perceptual processes operating in the face of inadequate or incomplete information from the stimulus.

Hallucinations are perceptual experiences involving distortion of actual stimuli or perceptions when no stimulus is present. They occur in psychotic states but also as a result of sensory deprivation, certain brain tumors, electrical stimulation of certain brain areas, drugs such as LSD and marijuana, and in fatigue states including going to bed and waking up. They are prob-

ably a result of brain processes that resemble in some way the processes which occur in normal perception, and they occur in normal as well as psychotic individuals.

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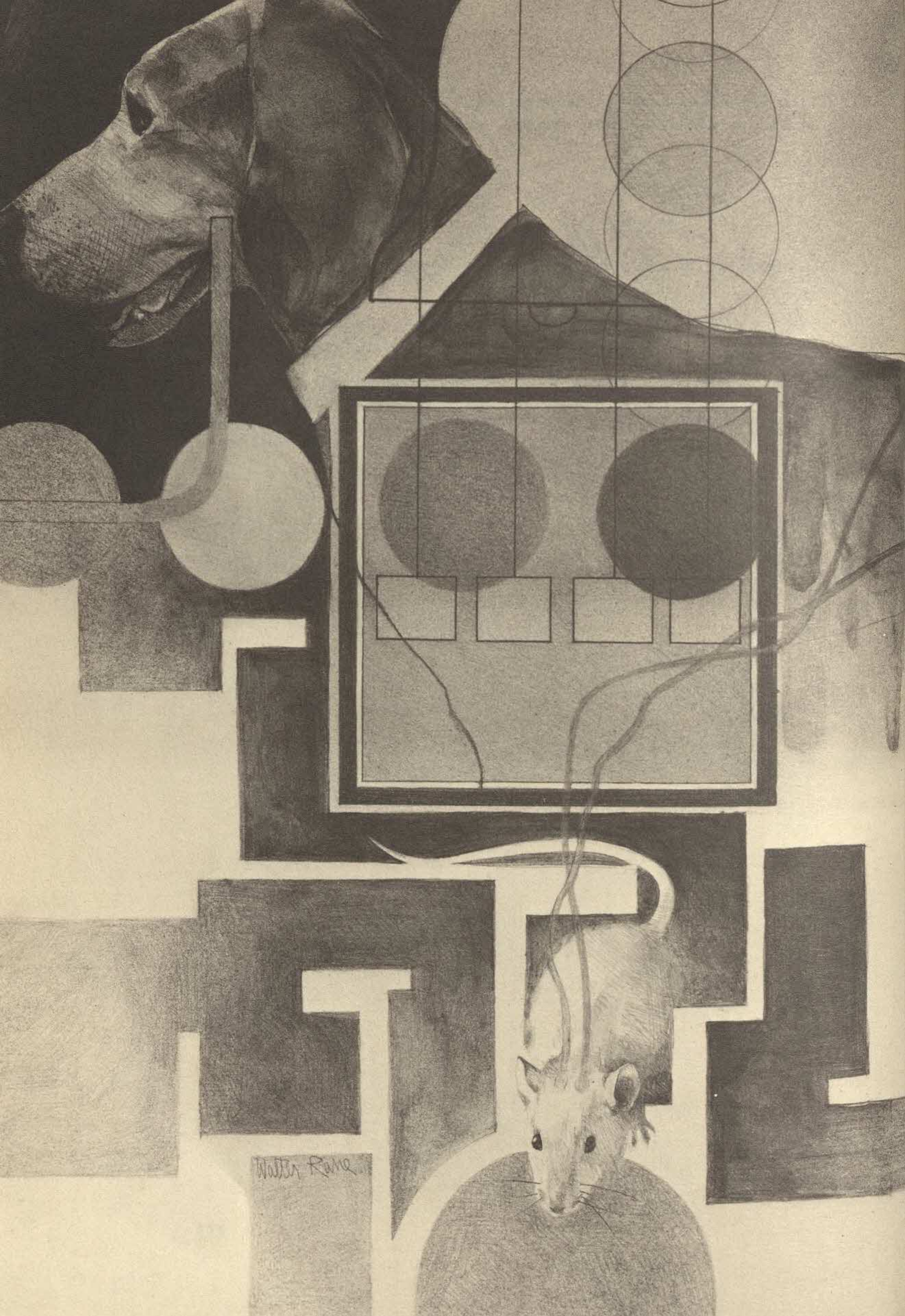

Walter Rane

Conditioning and Instrumental Learning

7

Some kinds of learning are uniquely human, or perhaps limited to higher primates, while others seem to occur in many different species of animals. In this chapter you will encounter several kinds of learning that are exhibited widely throughout the animal kingdom, and which seem to some psychologists to provide the basis for understanding *all* learning. This learning is divided into two broad classes: *classical conditioning* and *instrumental conditioning*. In classical conditioning new stimuli come to evoke behavior that could previously be evoked only by one or a few stimuli. Instrumental conditioning includes several subcategories of learning, all of which involve the establishment of new behavior that is "instrumental" in attaining some reward or goal, or in avoiding some punishment. A third kind of learning, less prevalent than the two main classes of learning, by which some animals learn to identify members of their species, is called *imprinting* (which will be discussed in Chapter 13).

From a historical perspective the study of conditioning reflects the convergence of two lines of thinking and research that developed in the nineteenth century. In philosophy the school of thought known as *associationism* was concerned with the nature of the connections, or associations, that presumably were the basis for complex ideas, thinking, etc. These associations were presumably established on the basis of the individual's experience that particular events go together, e.g., lightning and thunder. Once psychology became established as a science, it was natural for investigators to seek the empirical basis for the establishment of associations.

Evolutionary biology, stimulated so strongly by Darwin, stressed the importance of understanding similarities and differences between animals. When carried over into psychology, this emphasis led quite naturally to the study of the higher mental processes such as associations, in animals as well

as in man. The establishment of associations, or learning, became a very important topic for study. However, the early studies were anecdotal in nature, and in many cases investigators gave the impression that animals were very clever indeed. Experimental studies, initiated by Edward Lee Thorndike, applied more careful controls to the observations and the conditions of learning, leading to the conclusion that animals were not so clever after all. Rather, their learning processes appeared to be quite simple, consisting of the acquisition of elementary associations between stimuli and responses. These associations were then compounded to produce complex, seemingly intelligent behavior.

Definition of Learning

Before proceeding, it is necessary to point out some difficulties with the term *learning,* most of which arise from the fact that in ordinary language it is used more broadly than it is in psychology. Generally, the term refers to a change in behavior that is relatively permanent. It does not, however, refer to behavioral changes that are primarily the result of a developmental unfolding of biologically determined capacities. For example, the term *learning to walk* is inappropriate because walking is a behavior that is basically unlearned, and which seems to depend primarily upon developmental readiness. The term also does not refer to changes in behavior growing out of increases in muscle strength, say, from increased exercise. The changes in behavior which are included within the definition of learning come about as a result of *practice,* although there is no general agreement as to how much practice is necessary. Significant learning may occur in a single trial, or many trials may be required in some cases.

How permanent must the change be in order to be classed as learning? Again, the issue is not clear-cut. Excluded from the definition would be behavioral changes that could be classed as "habituations" or "temporary adaptations." For example, your visual sensitivity increases when you go into a dark room, but this change is clearly not learning. The habituation that you undergo when you "get used to" the clothes on your body so that you no longer feel them would also not be included within the definition of learning by most psychologists, although there is perhaps a legitimate case for viewing such habituation as a form of perceptual learning.

It is also necessary to distinguish between learning and performance. Obviously, a subject must perform some behavior if it is to show any learning. However, the learning is *a change within the subject,* while the performance is *what the subject does* as a result of that change, plus many other factors. Suppose that an animal performs better in a task when it is hungry. This fact does not necessarily mean that it has *learned* more as a result of the hunger. Separating out the factors that affect learning and performance is no easy task, and over the years there has been much discussion of this issue.

It does not make too much sense to force the matter of definition any

further at present. What you basically need to be aware of is that psychologists use the term learning in a more specialized way than laymen, and you should know some of the concepts that are and are not ordinarily included.

Classical Conditioning

Classical conditioning is a kind of learning in which a response comes to be given to a stimulus which previously could not bring out that response. It has been discovered and rediscovered by a number of investigators at least since the beginning of the nineteenth century, but was most systematically investigated by the Russian physiologist Ivan P. Pavlov (1929), who rediscovered it by accident while investigating the reflexes of the digestive system in dogs. Pavlov was interested in the secretion of saliva that occurred when he placed food in the dog's mouth. Although this response is clearly an unlearned reflex, he found that after a few days his dogs would begin to salivate *before* the food was placed in the mouth. Indeed, they would begin to salivate as soon as the experimenter walked into the room. Seeing that the dogs had in some sense learned to anticipate the food, Pavlov saw the possibility of studying experimentally the higher functions of the nervous system in a very objective way, and he began to explore these "conditional reflexes" in a systematic manner. Since Pavlov's time a number of other investigators all over the world have studied this form of conditioning, and it has been determined that a number of responses in addition to the salivary response can be conditioned. In fact, the evidence suggests that this kind of conditioning is responsible for most, if not all, of the learning of our repertoire of emotional responses (see p. 187) that we undergo during our lifetime.

Definitions

At this point, in order to proceed further with the discussion of classical conditioning, it is necessary to memorize four definitions.

The *unconditioned stimulus* (UCS) is a stimulus that automatically evokes the *unconditioned response* (UCR). The UCS–UCR relationship exists because the animal is "wired up" that way. It does not have to be learned, and is called an unconditioned reflex. Salivation (UCR) in response to food in the mouth (UCS) is such a reflex, and several others were mentioned in Chapter 4, including the eye-blink response to a speck of dust on the cornea, the knee jerk in response to a tap on the patellar tendon, and withdrawal of a finger or limb in response to a painful stimulus. An unconditioned reflex that has been subjected to much study in classical conditioning experiments is the galvanic skin response (GSR), in which the electrical conductivity of the skin is seen to increase. The GSR is a monitor of activity in the sympathetic division of the autonomic nervous system and is an important component of the conditioning of emotional responses.

The other two terms are *conditioned stimulus* (CS) and *conditioned response* (CR). The CS is a neutral stimulus that does not naturally call

forth the UCR. Thus, in Pavlov's example, dogs do not naturally salivate when they see people. Pavlov employed many different CSs in his studies, including a bell, a metronome, various stimulus cards pulled up in front of the animal, etc., none of which would naturally evoke the salivation.

The CR is the response that, after conditioning has occurred, comes to be given to the CS. The CR is, of course, the same as, or at least very similar to, the UCR. For all practical purposes the only difference is that the CR is given to the CS, and the UCR to the UCS. See Figure 7.1.

Conditioning Phenomena

Pavlov identified several distinct phenomena in his studies of conditioning. They are not limited to classical conditioning but also appear in instrumental conditioning as well. The phenomena are *acquisition, extinction, spontaneous recovery, generalization, discrimination, experimental neurosis*, and *higher-order conditioning*.

ACQUISITION

The acquisition process was studied with the experimental situation described in Figure 7.1. The UCS was meat powder delivered automatically to the dog's mouth; the CS was a bell. The measure of conditioning was the number of drops of saliva secreted in response to the CS on test trials in which the CS was administered alone, i.e., without being followed by the UCS. Clearly, if the bell were truly a neutral stimulus as described above, it should not have evoked any salivation the first time it was presented, and this fact was confirmed by presenting the bell several times and noting that no response occurred. Next, several trials were run in which the bell was

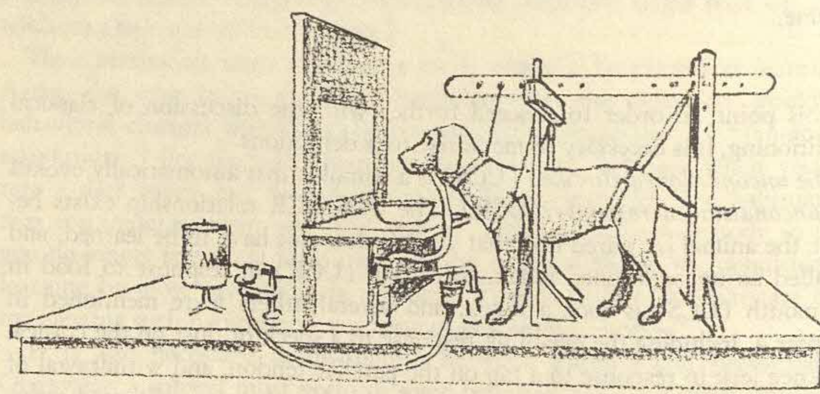


FIGURE 7.1 *Pavlov's experimental apparatus. The dog, restrained in the harness, has been operated upon so that one salivary gland secretes into the tube, rather than into its mouth. The saliva drips into the graduated cylinder after falling on the drop counter. The counter is connected to a kymograph in an adjacent room, which makes a record of each drop. Not shown are the devices for presenting the CS and the UCS. These stimuli were controlled from the adjacent room by means of pneumatic tubes. The dog could be watched through the window.*
From Yerkes and Morgulis, 1909.

presented, and then, a few second later, the meat powder was presented. The dog, of course, salivated quite well to the meat powder, since this is a biological UCS for the salivary UCR. After several trials the bell was presented alone and the amount of saliva was noted. Then a few more trials with the bell and meat powder were run, followed by another test trial with the bell alone. This sequence was repeated a number of times. The results can be represented graphically as shown in Figure 7.2. On the horizontal axis of Figure 7.2(a) is plotted the number of conditioning trials (trials on which the CS and the UCS were paired). On the vertical axis is plotted the number of drops of saliva secreted on the test trials (CS alone), following a given number of conditioning trials. Notice the shape of the curve in Figure 7.2(a). The number of drops increased quite rapidly at first, and then began to level off, or reach *asymptote*, where no further improvement was seen. This curve is quite typical of those found in studies of learning, and is called a *learning curve*, or *acquisition curve*.

EXTINCTION

What happened when the meat powder, or UCS, was suddenly removed and the bell, or CS, presented alone? The answer is seen in Figure 7.2(b). The conditioned response gradually became weaker, i.e., less and less saliva was secreted. This process is called *extinction.* Notice that the extinction curve is more or less like the acquisition curve flipped over about the horizontal axis. The response diminishes rapidly at first, and then more slowly. In fact, it could be said that the extinction process is itself a kind of learning: learning not to respond when the UCS is removed. The matter is not quite that simple, however, as you will see in the next section.

SPONTANEOUS RECOVERY

Suppose that at the end of the first day of extinction the animal goes back to its cage and waits until the next day, at which time it is once again placed in the apparatus and the CS is presented alone. In such a situation the conditioned response frequently reappears, but the strength is less than it was

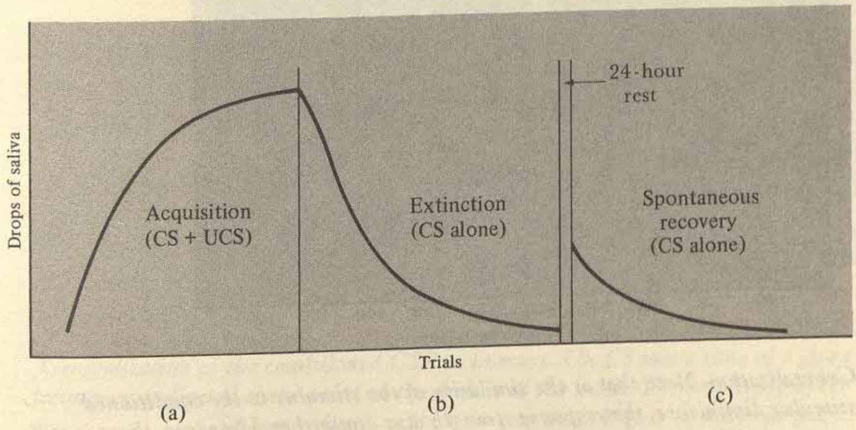


FIGURE 7.2 *Acquisition, extinction, and spontaneous recovery.*

at the beginning of the day before. This phenomenon is called *spontaneous recovery* [see Figure 7.2(c)].

Various explanations for spontaneous recovery have been given. In one case it is assumed that two processes are operating in the animal during extinction. One of these processes is akin to fatigue, and involves a temporary reduction in responding when the UCS is removed. After rest, this process no longer operates. The second process is learning not to respond, as mentioned above. During extinction both processes are brought into play. The temporary process disappears after rest, but the learned process is relatively permanent. Spontaneous recovery, then, reflects the recovery from the fatigue-like process; the fact that the response strength is lower than it was just before extinction was begun is caused by the animal's learning not to respond. If the extinction treatment is carried out for several days, more and more learning not to respond will occur; eventually, the response will disappear completely. Thus complete extinction requires complete learning not to respond.

GENERALIZATION

Pavlov discovered very early in his investigations that once a conditioned response was established, it could be evoked by stimuli other than the CS to which the response was originally established. The more similar the new stimulus to the CS, the greater would be the response to it. This phenomenon is called *generalization*, and reflects the fact that the conditioning effect is not limited to one specific conditioned stimulus. Suppose that the CS is a metronome beating 120 times per minute, and a good CR is established to that CS. Next, the beat of the metronome is changed to 110 beats per minute, then to 100, 90, 130, 140, 150, etc., and the response measured for each of the new stimuli. Results from a hypothetical experiment are depicted in Figure 7.3. Note that as the number of beats per minute varies from the original rate of 120, the amount of saliva diminishes. The results of another

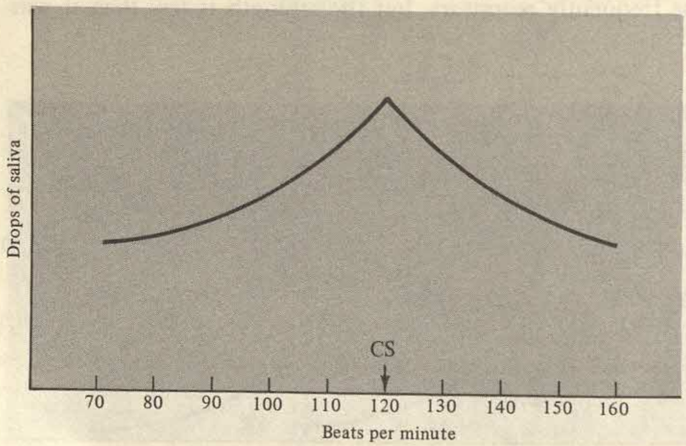


FIGURE 7.3 *Generalization. Note that as the similarity of the stimulus to the conditioned stimulus diminishes, the response strength also diminishes. However, there is still some responding to all of the stimuli.*

experiment are shown in Figure 7.4. Human subjects were used. The CS was a tone, the UCS a mild electric shock, and the UCR the galvanic skin response. After the CR was established to one tone, the frequency of the tone was varied in several test trials, and, as you can see, the response generalized to the other tones, but the strength was reduced as the test tones differed more and more from the original CS.

DISCRIMINATION

Just as an animal will give a conditioned response to stimuli that are similar to the CS through the process of generalization, one can also train a subject to withhold the response when stimuli other than the CS are presented. This process is called *discrimination* training. It is accomplished by presenting the UCS only after the CS. The other stimuli to be discriminated from the CS are presented, but the UCS is omitted. Thus the responses to stimuli other than the CS are extinguished, while the response to the CS remains at a high level of strength, since it is always followed by the UCS. Another way of putting it is that the response to the CS is *reinforced* by presenting the UCS, while the responses to the other stimuli are not reinforced. (The concept of reinforcement is a very important one in learning, especially in instrumental learning, and will be discussed later.) An example of discrimination training in classical conditioning is given in Figure 7.5.

EXPERIMENTAL NEUROSIS

Pavlov discovered the phenomenon of experimental neurosis when he was studying discrimination. The question arose as to what would happen if the discrimination were made more and more difficult by making the nonreinforced stimuli more and more like the CS. In one such experiment a dog was trained to salivate when presented with a circle, and then a discrimination between the circle and an ellipse was established by extinguishing the

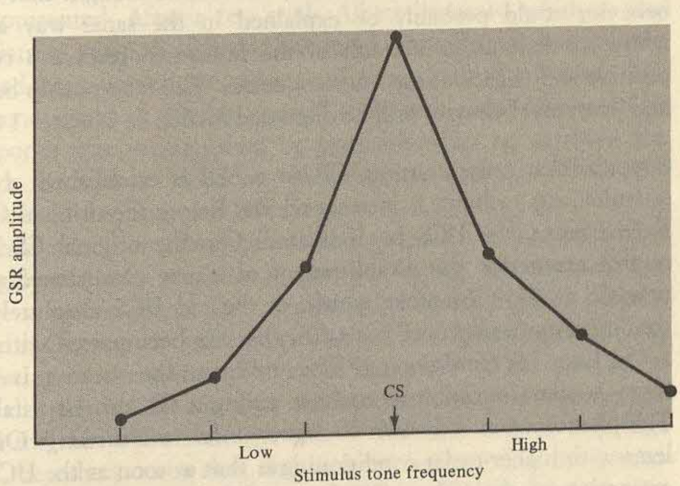


FIGURE 7.4

Generalization of the conditioned GSR in humans. The CS was a tone of a given frequency, indicated at the point on the middle of the x axis. The amplitude of the GSR was reduced as the tone was made higher or lower in pitch. Adapted from Hovland, 1937.

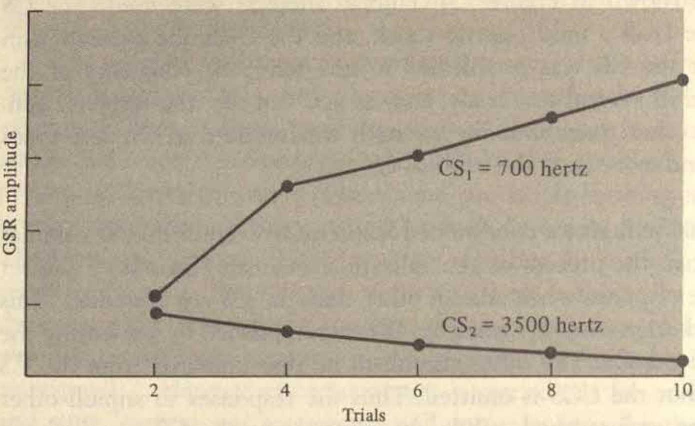


FIGURE 7.5 *Discrimination in the conditioned GSR in human subjects. Note that the response to the nonreinforced stimulus, 3500 hertz, diminishes to nearly zero over the course of 10 trials, while the response to the positive CS, 700 hertz, shows an increase.*
From Baer and Fuhrer, 1968.

response to the ellipse. Then the ellipse was made more and more like the circle by gradually reducing the difference between the major and minor axes. At a critical point the behavior of the animal "broke down," so to speak. It began to salivate indiscriminately to all stimuli, became quite restless, and occasionally refused to allow the experimenter to place it in the apparatus the next day. Pavlov thought the behavior of the animal was similar in many ways to that of neurotic human patients, so he called the phenomenon experimental neurosis. Indeed, he thought that human neurotic behavior could probably be explained in the same way as experimental neurosis—that is, as a result of the failure to resolve a conflict between positive and negative response tendencies. The relationship between conflicts and irrational behavior will be discussed further in Chapter 14.

HIGHER-ORDER CONDITIONING

Suppose that once a strong CR to a bell is established, a *second* neutral stimulus, e.g., a light, is introduced just before the original CS is presented. Furthermore, the UCS is eliminated. Can the original CS (CS_1) serve as reinforcement for the establishment of a new conditioned response to the new CS (CS_2)? In other words, is the old UCS absolutely necessary for conditioning to occur, or can a CS_1 that has been paired with the UCS serve as the basis for conditioning? The answer to the question is "yes," although there is some question as to how strong a CR can be established to CS_2. The phenomenon is known as *higher-order conditioning.* One of the problems with higher-order conditioning is that as soon as the UCS is eliminated, extinction of the CR to CS_1 begins. Therefore, only a limited number of trials with CS_2 is possible before the response to CS_2 extinguishes. Even so, investigators have been able to demonstrate the existence of second-order conditioning, where CS_2 becomes effective on the basis of pairing with CS_1. There is even some evidence for third-order conditioning, where CS_3 can be

made to evoke the CR by pairing it with CS_2. Clearly, higher-order conditioning is a very important phenomenon if classical conditioning is to have any general explanatory value for learning in complex situations.

Significance of Classical Conditioning AS A UNIT OF LEARNING

Not long after Pavlov's discoveries were made public, some psychologists, including the founder of behaviorism, John B. Watson, became very excited because they thought that they could show that all complex behavior was the result of a combination of conditioned responses. This idea was very important to them, since they were concerned with giving an account of behavior that did not involve reference to mentalistic concepts such as will and consciousness. Since the conditioned response was quite objective, in that it was easy to observe and the conditions under which it was established were fairly explicit, it is no wonder that conditioning seemed at that time to offer an explanatory panacea. Few if any psychologists in this day and age are willing to adopt such a scheme for explaining learning, however, because it has become quite clear that there are forms of learning that cannot be reduced to classically conditioned reflexes. Nevertheless, the limits of applicability of classical conditioning have never been firmly established, and it is probably quite important in many kinds of learning.

THE LEARNING OF AFFECTIVE RESPONSES

One of the most important things about classical conditioning is that many emotional responses are probably acquired through this kind of learning. Watson and Rayner (1920) demonstrated this point years ago in a now-famous experiment involving a child named Albert. The UCS in this experiment was a loud sound, and the UCR was fear. Such a reaction is normal for young children, and the fear can be noted by signs such as whimpering, cringing, etc. The CS was a white rat. Every time the rat was brought in, the sound was presented. After a few trials Albert began to whimper and show signs of distress when the rat was presented alone. In other words the fear response had been conditioned to an otherwise neutral stimulus. The response also generalized to similar stimuli such as a man with a white beard. The response was extinguished by presenting the rat without the loud sound, and, in order to speed up the extinction process, Albert was also given ice cream at the same time he saw the rat.

There are other indications that emotional responses are classically conditioned. The galvanic skin response is one of several responses of the autonomic nervous system to painful, surprising, or fear-provoking stimuli. As pointed out in Chapter 4, other responses include speeding up of the heart beat, sweating of the palms, dilation of the pupil of the eye, and a shifting of the distribution of blood in the body so that the muscles get more blood and the skin and viscera get less. When one of these responses occurs, most of the others occur also, and thus we can say that the sympathetic nervous system is conditioned. If you will consider sympathetic activity as one index of fear, it should be clear that the subject has had at least part of his fear reaction conditioned. There is, moreover, some evidence that fear is partly caused by one's perception of these autonomic reactions.

Another kind of affective response is the perceived pleasantness or un-

Therapeutic Conditioning

It is becoming increasingly clear that many maladaptive, neurotic patterns of behavior are learned reactions, and that they can be unlearned if the appropriate techniques are used. There are by now numerous instances in which deviant behaviors have been successfully eliminated through the use of procedures of operant and classical conditioning. While proponents of the psychoanalytic and other psychodynamic schools of thought (see Chapters 16 to 18) would argue that the deviant behavior was the result of some underlying unconscious process which, once the behavior was eliminated, would manifest itself in the form of some other symptoms, there seems to be little evidence that this is the case.

Clark (1963) describes a case that nicely illustrates one of the learning procedures that has been used—desensitization. In desensitization one uses a classical conditioning approach; it has been quite effective in eliminating phobias in some people. (Phobias are irrational fears which, it is argued, are learned responses to particular conditioned stimuli.) The way, then, to eliminate the response is either to extinguish it or substitute an incompatible response. The case in question involved a woman who was afraid of birds. Her fear was quite debilitating, in that she could not go outside for any length of time for fear of being attacked by birds. Her fear even generalized to feather pillows and hat feathers. Obviously, it interfered with her daily life to such an extent that its elimination would be quite desirable.

The procedure used with this patient was to induce relaxation through the use of mild hypnosis coupled with posthypnotic suggestion that she would continue to be relaxed. Her arousal level was monitored with a GSR apparatus as a check on her verbal reports of arousal. When she was fully relaxed, she was shown a single bird feather at a distance of 12 feet. She was told that, if at any time she felt anxious, to say so, and the feather would be taken away. The feather was brought closer and closer, as long as no adverse reaction occurred. As soon as she reacted with anxiety, it was removed, and she was reassured with soothing words. As soon as she was able to tolerate the feather at a close distance, a more threatening stimulus object was introduced in the same way. Gradually, more and more threatening objects such as a bundle of feathers, a stuffed blackbird with wings folded, a stuffed pigeon with wings outspread, a live bird in a cage, chickens, ducks, etc., were introduced, and she was desensitized to their presence. After twenty sessions she was no longer afraid of birds.

The use of desensitization has had quite a measure of success. What seems to be happening is that the internal response we call anxiety is extinguished if the threatening stimulus is introduced when the patient is relaxed. It is essential, however, to start with a stimulus that is only a weak elicitor of anxiety. Otherwise, the anxiety response would override any effect of the relaxation instructions. Thus the patient is asked first to order a set of stimuli in a hierarchy, from most to least feared, and the lowest one on the hierarchy is the one used first.

pleasantness of objects, and there is some indication that classical conditioning may be involved in the development of these attitudes. Staats and Staats (1958) had subjects first learn a list of words in which certain critical words were preceded by words with a positive connotation (*good, nice*, etc.), while other critical words were preceded by words with a negative connotation (*dirty, ugly*, etc.). When these same subjects were later asked to rate the critical words on a scale of pleasantness, they tended to rate them as pleasant if they had been preceded by the pleasant words, and unpleasant if they had been preceded by the unpleasant words. Thus, the Staatses argued, the subjects' attitudes had been conditioned.

If it is true that many human fears are classically conditioned, then it should be possible to eliminate some of them, especially irrational or harmful ones (such as fear of snakes, fear of riding in a car, etc., which might interfere in one's daily activities) by the process of extinction. Thus, in recent years the applictaion of classical conditioning principles to the treatment of neurotic disorders has developed into a substantial subspeciality within clinical psychology (see p. 188). This kind of treatment, known as behavior therapy, will be discussed more fully in Chapter 18.

Instrumental Learning

From the previous section you saw that in classical conditioning the response is "called out," or evoked, first by the UCS and then by the CS. Instrumental learning is different, in that the response is *emitted* by the animal. Ordinarily, there is no UCS to evoke the response, so the experimenter must either wait around for the response to occur or else he must use a procedure called *shaping* (discussed later in this chapter) to build up the response out of those behaviors that the animal readily emits. Once the response is emitted, however, it has a particular effect or outcome, called *reinforcement*, which determines whether the behavior will occur again. The reinforcement is in some sense equivalent to the UCS in classical conditioning, but its relationship to the response is different. In classical conditioning the *UCS evokes the response*, while in instrumental conditioning the *response brings on the UCS*.

Some of the earliest experiments in instrumental learning were conducted by Edward Lee Thorndike (1898), who placed cats in puzzle boxes and studied their efforts to get out. This kind of learning may be called *response learning*. *Maze learning*, whereby an animal learns to get from a start box to a goal box by going through a maze of alleys, also played a prominent role in the development of modern approaches to instrumental learning. Also of importance is *discrimination learning*, in which a subject must learn to respond to one or two or more different stimuli in order to obtain some reward. More recently, largely as a result of the work of B. F. Skinner, *operant conditioning*, in which the subject makes some response that "operates on" the environment to produce a reward or to avoid or escape some punishing stimulus has become a prominent form of instrumental learning

(see Figure 7.6). Each of these forms of learning will be discussed in turn.

Instrumental learning may occur because the goal is positive such as food, or it may be aversive such as electric shock or some other noxious stimulus. Instrumental behavior directed toward positive goals is sometimes called appetitive (c.f. appetite), while that directed away from negative goals is called aversive. A special kind of aversive learning is learning to *avoid* potentially punishing stimuli. Since avoidance learning is theoretically important in terms of the relationship between classical and instrumental learning, it will be discussed last.

Response Learning

The first systematic studies of animal learning were conducted by Edward Lee Thorndike (1898), who used hungry cats as subjects and placed them in puzzle boxes (Figure 7.7). The cat could get out if it discovered how to open the door to the box. One box might require a lever to be pushed, another one a ring to be pulled, etc. Food was clearly visible outside the box, and, since the animals had been previously deprived, they were highly

FIGURE 7.6 *B. F. Skinner, whose initial discoveries and later work in operant conditioning, educational technology, and behavior modification have been most influential in the development of our understanding of instrumental learning.*
Courtesy of B. F. Skinner.

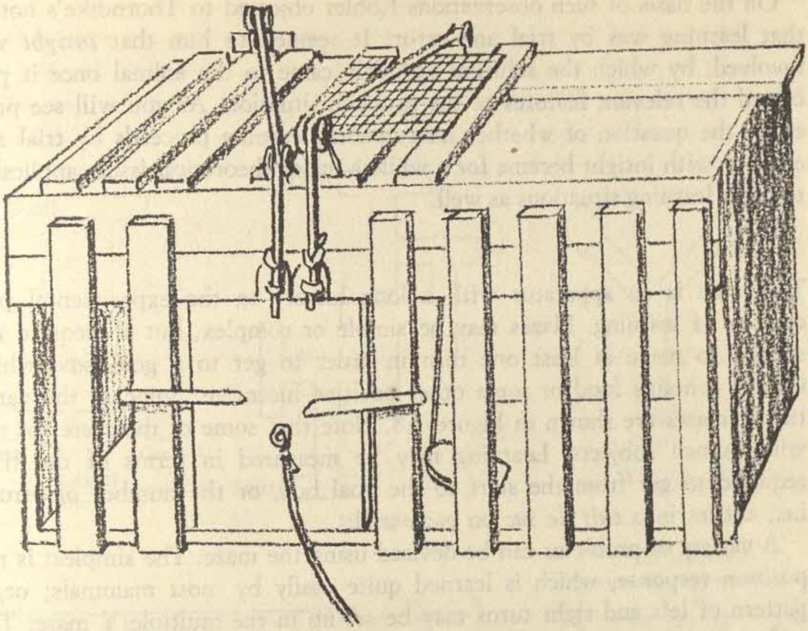


FIGURE 7.7

A puzzle box for cats. The problem for the cat is to learn to manipulate the levers, pedals, etc., in order to open the door. Thorndike's ideas about trial-and-error learning came from experiments using boxes such as this one. From Garrett, 1951.

motivated to get out. Thorndike's observations led him to suggest that the animals learned by *trial and error.* They would engage in a variety of behaviors, by chance hitting on the one that worked. After a number of trials the animals would immediately perform the correct action.

Wolfgang Köhler (1927), the Gestalt psychologist, made observations of response learning by chimpanzees. He made up problems such as the following: A banana was placed outside the animal's cage, too far away for it to be reached. There were two sticks inside the cage, neither one of which was long enough for the animal to reach the banana. The sticks, however, could be put together to make a single stick that was long enough. After describing in some detail the unsuccessful attempts of Sultan, the chimpanzee, to reach the fruit with one stick, or to get it by pushing one stick with the other one, Köhler gave the following account of the behavior of the chimpanzee.

> Sultan first of all squats indifferently on the box, . . . then he gets up, picks up the two sticks, sits down again on the box and plays carelessly with them. While doing this, it happens that he finds himself holding one rod in either hand in such a way that they lie in a straight line; he pushes the thinner one a little way into the opening of the thicker, jumps up and is already on the run towards the railings, . . . and begins to draw a banana towards him with the double stick. [Köhler, 1927, p. 127]

On the basis of such observations Köhler objected to Thorndike's notion that learning was by trial and error. It seemed to him that *insight* was involved, by which the solution suddenly came to the animal once it perceived the relevant features of the problem situation. As you will see presently, the question of whether instrumental learning proceeds by trial and error or with insight became for a while a major theoretical issue, applicable to other learning situations as well.

Maze Learning

The maze is an apparatus with a long history in the experimental psychology of learning. Mazes may be simple or complex, but all require the subject to make at least one turn in order to get to a goal box, which usually contains food or some other positive incentive. Some of the varieties of mazes are shown in Figure 7.8. Note that some of them are for use with human subjects. Learning may be measured in terms of the time required to get from the start to the goal box, or the number of errors, i.e., entries into *culs de sac* on each trial.

A variety of problems can be devised using the maze. The simplest is the position response, which is learned quite easily by most mammals; or, a pattern of left and right turns may be set up in the multiple Y maze. The stylus maze for humans is set up on the same principle. The temporal maze is important because of its use in *alternation learning* (see Chapter 11). The problem is to execute a pattern of turns to the right (R) or left (L), such as RLRLRLRL, etc., called single alternation; RRLLRRLLRRLL, etc., called double alternation, and so on. The task is of interest because the subject must learn the correct pattern of responses and remember his behavior on the preceding trials in order to solve the problem. In other words, the maze provides not only a test of the ability to learn a pattern, but also to remember what was done on previous trials, and perhaps requires thinking as well.

Discrimination Learning

The main focus of interest in discrimination learning is not so much whether an animal or person can learn a particular response. Rather, the focus is upon learning to respond differentially to two or more stimuli. Discrimination learning has been touched on briefly in the previous discussion of classical conditioning. There are, however, other techniques as well. In any of the techniques the particular response used as an index of discrimination is more or less irrelevant; it is only necessary that it show that the animal can tell the difference between the stimuli involved.

Discrimination learning is quite important in studies of perception in organisms that cannot talk. For example, Fantz (1961), whose work with infant perception was discussed in the previous chapter, employed discrimination learning procedures. The only difference is that, rather than train the babies to respond differentially to the patterns, he used an unlearned (or perhaps previously learned) preferential response to one of the two

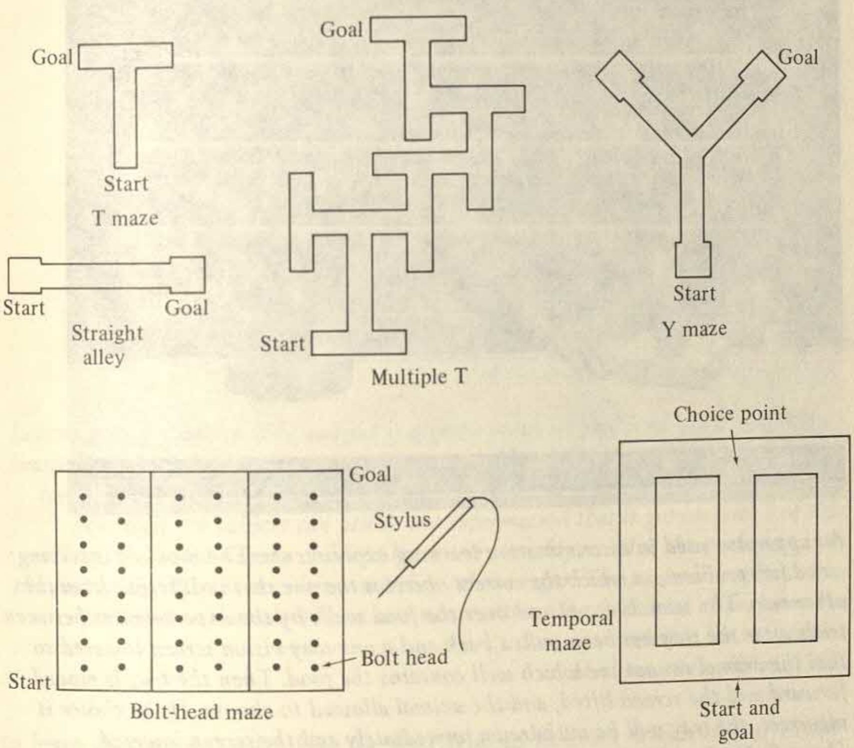


FIGURE 7.8

Several different mazes used in learning experiments. In each, there is a starting point and a goal, and a series of one or more choices that must be made. (An exception is the straight alley, in which the animal must simply run from one end to the other.) In the temporal maze the subject must make a particular pattern of turns at the choice point, and it is reinforced only if the correct pattern is made. The bolt-head maze is used with human subjects. The one shown has 24 choice points. Beginning at "start," the subject must place the stylus on either the right or the left bolt-head, only one of which is correct. He then proceeds up to the next pair, and on through to the end. The stylus is wired so that either a shock for an incorrect choice or a signal indicating a correct choice, or both, can be presented automatically at each choice point.

patterns as his index of discrimination. By demonstrating a preference, the babies demonstrated that they could discriminate the stimuli. The matter is not so easy in studies using animals, since it is usually necessary first of all to train the subject to make some response and then train him to discriminate. Some situations in which visual discrimination learning has been studied in animals are illustrated in Figure 7.9.

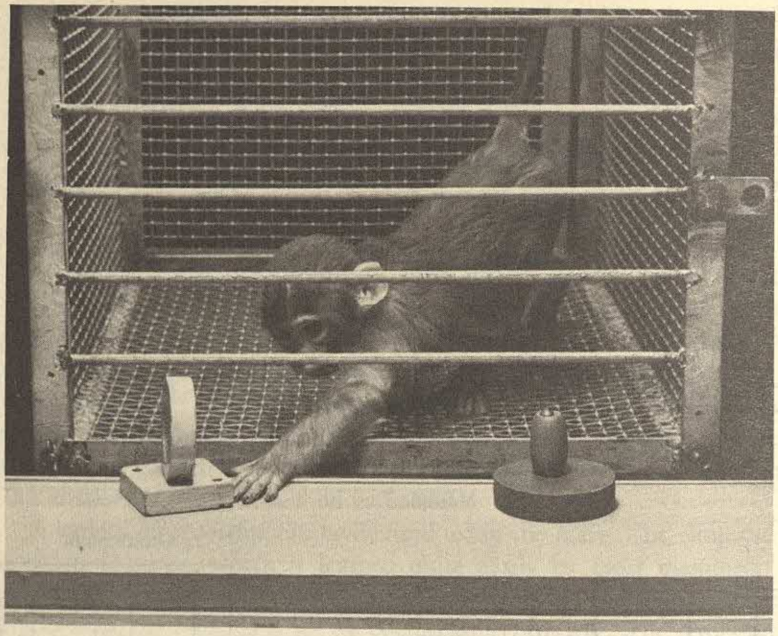


FIGURE 7.9 *An apparatus used in discrimination learning experiments. The monkey is solving an oddity problem, in which the correct object is the one that is different from the other two. The stimuli are placed over the food wells by the experimenter between trials after the tray has been pulled back and a one-way vision screen lowered so that the animal cannot see which well contains the food. Then the tray is moved forward and the screen lifted, and the animal allowed to choose. If the choice is incorrect, the tray will be withdrawn immediately and the screen lowered.* *Harry F. Harlow, University of Wisconsin Primate Laboratory.*

LEARNING SET FORMATION

Discrimination learning not only reflects the ability of the animal's perceptual processes, but also is indicative of its ability to make use of past experience in the solution of new problems. For example, consider a monkey trained in a Wisconsin General Test Apparatus (Figure 7.9) to discriminate a toy car from a square block of wood. The problem is arranged so that the toy always has a raisin under it in a shallow food well, while the block has nothing but an empty well under it. From trial to trial the positions of the objects are shifted so that the problem cannot be solved simply by responding always to the right or left object. If the problem is the first one that the animal has ever been presented with, it will probably take him 20 or 30 or more trials to learn it, i.e., to select the toy car on each trial After the first problem is learned, a second problem using two different objects is introduced, which will be learned in somewhat fewer trials. After many problems, each new problem will be solved in a very few trials, and the animal is said to have developed a *learning set.* In other words, he has learned how to learn.

The development of learning sets is much easier for "higher" than for "lower" animals (Fig. 7.10) and seems to reflect the ability of the animals

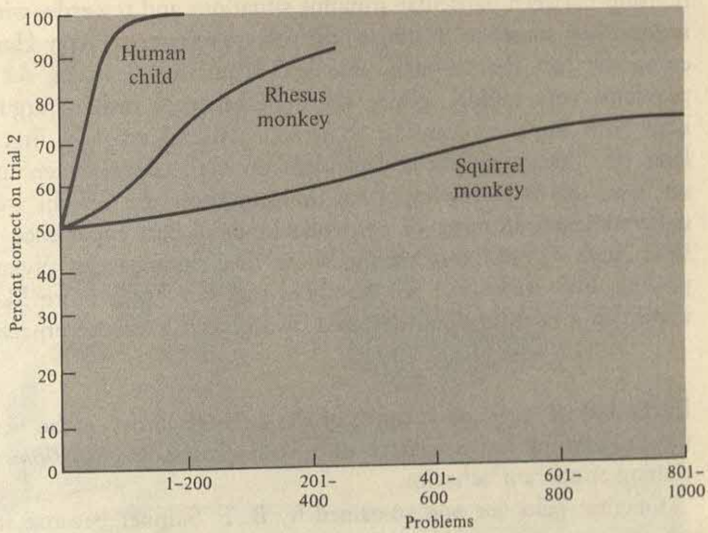


FIGURE 7.10

Learning set formation. The subject is given a series of problems, each with only a limited number of trials (e.g., six trials per problem). The measure of learning set formation is the percentage of correct responses on trial 2 of each problem, i.e., how well the subject can utilize the information that it got on trial 1 of that problem. Note that human children learn very quickly to solve the problems after the first trial, whereas the rhesus monkey takes longer. The squirrel monkey takes even longer than the rhesus and never attains the final level of performance possible for the rhesus.
Harlow, 1949; Miles, 1957.

to learn the general rule: Use the first trial to find out which object is correct, and then apply that information until the problem changes.

INSIGHT OR TRIAL AND ERROR?

In all of the above learning situations the question arose as to how best to characterize what happened to the animal as it learned to make the correct response, negotiate the maze, or select the correct stimulus. Thorndike thought that the animal would try various responses, more or less randomly, or perhaps based on its previous experience, until it came across one response that worked. That response, it was argued, was "stamped in" by virtue of the pleasant state of affairs that followed it. Köhler, however, argued that, on the contrary, the animals that he studied showed insight. That is, they gave the appearance of coming to some "understanding" of the situation without necessarily trying a lot or responses. Behavioristically oriented psychologists were unwilling to accept the apparently mentalistic notions about insight, and the Gestalt psychologists were convinced that the behavioristic explanations were at best oversimplifications and at worst completely wrong.

Edward C. Tolman, a behaviorist, attempted to bridge the gap with the idea that learning involved the acquisition of expectations about the rela-

tionship between particular stimulus situations and rewards, with the expectations then somehow leading to the correct response. Harry Harlow (1949) citing the fact that animals who had acquired a learning set could solve problems very rapidly, giving the appearance of insight, argued that perhaps both kinds of learning occurred, trial and error at first and insight later. If, indeed, insight is dependent upon the development of a learning set, then this is a very important thing to know, for insight would then be understandable in terms of particular kinds of past experience. Along these lines Birch (1945) was able to show that chimpanzees, given practice in playing with sticks and putting them together, were more likely to show insight in a problem like that used by Köhler than were untrained animals.

Operant Conditioning

In the last 40 years or so much of the research effort in the field of instrumental learning has focused upon so-called *operant conditioning,* or conditioning of operant behavior.

Operant behavior was so-named by B. F. Skinner because it "operates" on the environment to produce some effect. A particular piece of such behavior is called an operant, and the process of developing and gaining control over operants is called operant conditioning.

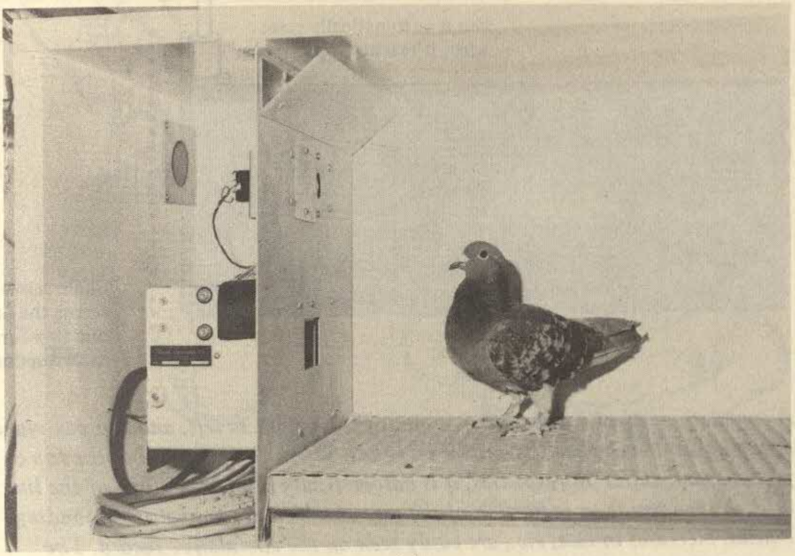
Proponents of this approach to learning argue that through the study of operant behavior, one can find out a great deal about the factors controlling behavior and, indeed, can do so with great precision. As you will see, operant techniques have been applied to a wide range of problems with what appears to be a high degree of success.

A Skinner box, named after its inventor, is shown in Figure 7.11. It consists of a box, a lever, some means of providing reinforcement, and a means of recording behavior. The lever is connected to the reinforcement (usually food or water) device so that when the animal responds by pressing the lever, food or water will be delivered to the cup. The response is usually recorded on a *cumulative recorder.* This recorder gives a time history of the animal's responses; inspection of the cumulative record will tell you how fast the animal is responding and how many pellets of food it receives in a given period of time. The way the cumulative recorder works is shown in Figure 7.12. The box may also contain a stimulus panel of some kind on which a visual stimulus can be displayed, or it may contain a loudspeaker for presenting sound stimuli; some boxes also contain electrified grid floors to shock the animal's feet.

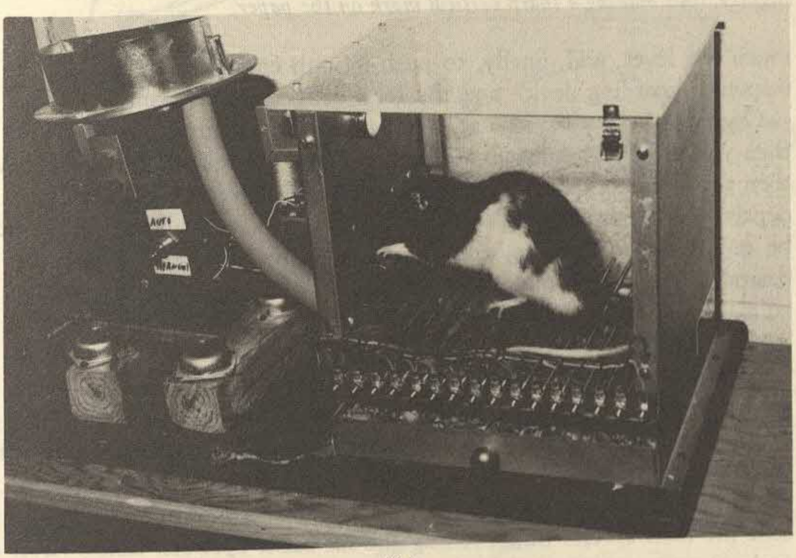
SHAPING

If you obtain a Skinner box, put a rat in it, and expect the rat to go immediately to the bar and begin pressing, you will be disappointed. Unlike classical conditioning you cannot evoke the response to be conditioned by simply presenting a UCS. Remember that the response must be *emitted* by the animal, and there is usually no natural stimulus which will automatically evoke it. Instead, the response must be *shaped.*

Shaping an operant requires some skill, and is accomplished by reinforcing *successive approximations* to the desired response. What one must do



(a)



(b)

Two Skinner boxes. In (a) the pigeon must peck the circular key to be rewarded. In (b) the rat presses the lever to obtain reinforcement. Photographs by M. C. Morrow. FIGURE 7.11

first is to list the components of the behavior you would like the animal to learn. For example, it would be helpful if the animal faced the end of the box where the lever is, rather than some other part of the box. Then it would be helpful for the animal to be oriented to the lever itself, then to

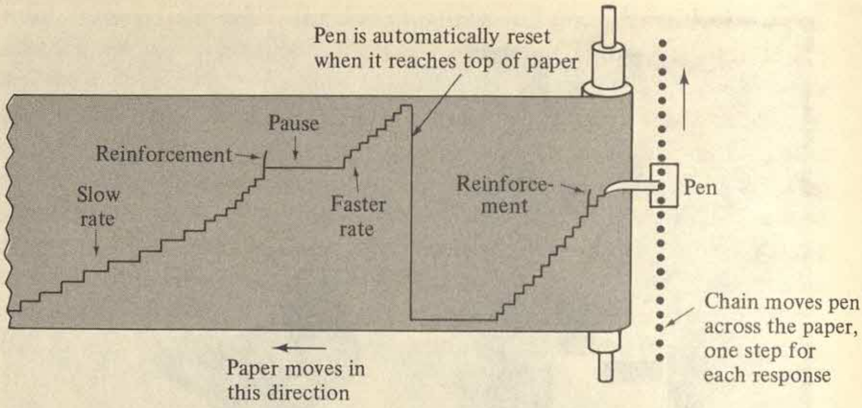


FIGURE 7.12 *A cumulative recorder. The paper is moved from right to left, and the pen makes a step upward each time the animal responds. When the pen reaches the top of the paper, usually after 50 responses, it is automatically reset. The slope of the line made by the pen is an indication of the rate at which the animal is responding. Pauses, increases in rate, etc., are easily seen on the cumulative record. The presentation of a reinforcement may also be shown by causing the pen to rotate slightly, thus making a sharp vertical mark on the paper.*

touch the lever, and, finally, to push it with enough force to activate the response recording device and the food delivery mechanism.

Once you have some idea as to what the components of the behavior are, then you are ready to begin. If food is to be the reward for the behavior, then you need to make sure that the food will indeed be rewarding, so you deprive the animal of food for a period of time, say, 24 hours. A rat would be quite hungry by then, and also quite active. Both of these states are desirable, hunger so that the food will "work," and activity so that the animal emits more behavior, some of which is part of the behavior you wish to shape.

Now you put the rat in the box and, as soon as he faces the lever, you push a button and activate the food delivery. Unfortunately, if this is also the rat's first experience with a Skinner box, then it will probably run to the opposite corner and try to hide, since noise from the food magazine will probably frighten it. Therefore, *magazine training* is desirable. Simply present the food several times, letting the rat eat it between times. After several magazine training trials the fear of the noise will have been reduced and the animal will also be oriented toward the business end of the box. Next, deliver the food if it moves toward the lever. After a few more trials, wait until it touches the lever for, say, a second or so. Then make it push the lever before delivering the food. In other words, as the animal acquires more and more of the total pattern of behavior, you establish a higher and higher criterion for reinforcement. Finally, disconnect the button and connect the lever, and let the animal deliver its own reinforcement.

The method of successive approximations is quite effective for training very complex patterns of behavior, called chains. One of these chains is illustrated in Figure 7.13. All you have to do to become an expert animal

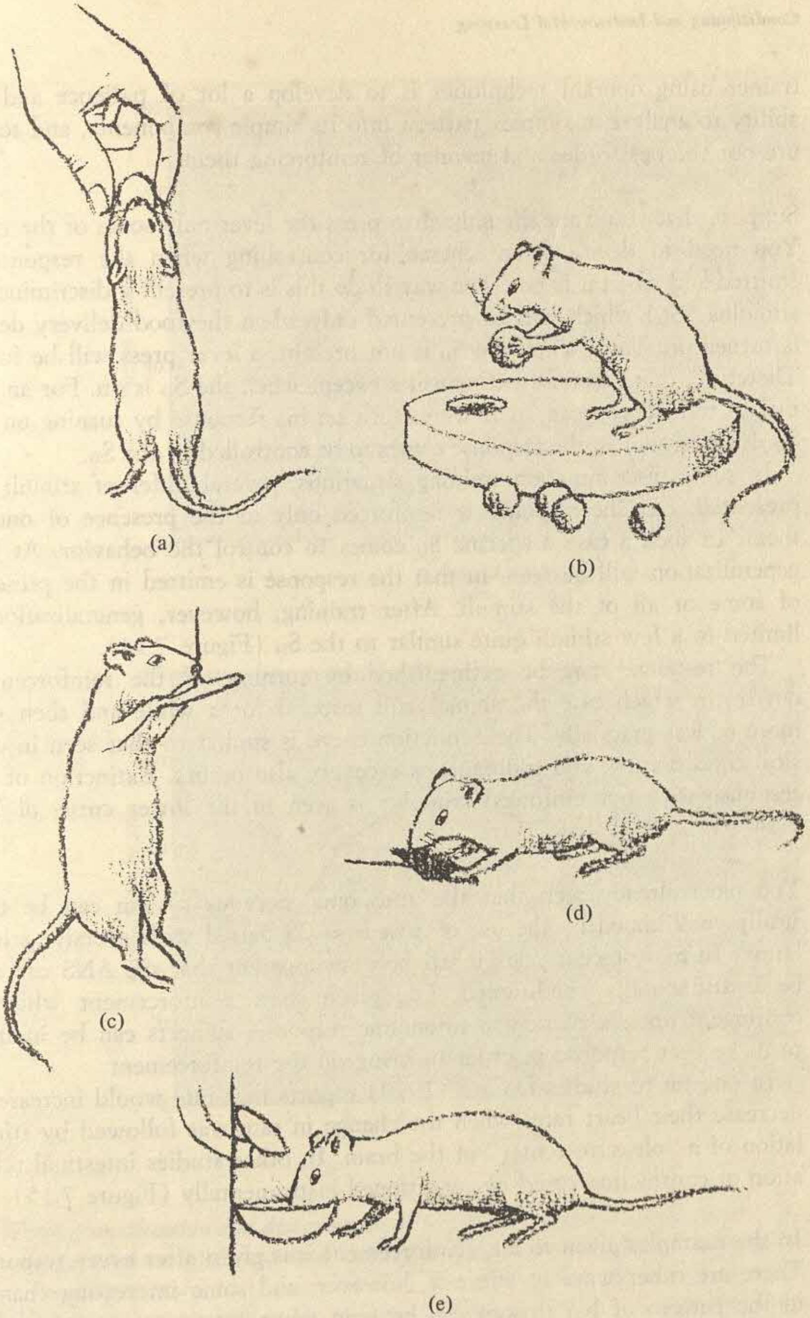


FIGURE 7.13

An example of chaining. Michael (1963) describes how to train a rat to perform the sequence indicated in the figure. (a) A marble is obtained from the experimenter, which (b) is then dropped into a hole. (c) the animal reaches up and pulls on a trapeze, and then (d) presses a lever 10 times, after which (e) food is delivered and the animal eats it.
From Michael, 1963.

trainer using operant techniques is to develop a lot of patience and the ability to analyze a complex pattern into its simple components, and to figure out the best order and manner of reinforcing them.

STIMULUS CONTROL

Suppose that you want the animal to press the lever only some of the time. You need to devise some scheme for controlling when the response is emitted and when it is not. The way to do this is to present a discriminative stimulus (S_D) which will be presented only when the food delivery device is turned on. Thus, when the S_D is not present, a lever press will be futile. Therefore, that response extinguishes except when the S_D is on. For an animal so trained you can, as it were, turn on his response by turning on the S_D. In other words, the response comes to be controlled by the S_D.

In some discrimination training situations, several different stimuli are presented, but the response is reinforced only in the presence of one of them. In such a case a specific S_D comes to control the behavior. At first generalization will be seen, in that the response is emitted in the presence of some or all of the stimuli. After training, however, generalization is limited to a few stimuli quite similar to the S_D (Figure 7.14).

The response may be extinguished by turning off the reinforcement device, in which case the animal will respond for a while and then stop more or less gradually. The extinction curve is similar to that seen in classical conditioning, and spontaneous recovery also occurs. Extinction of the response to a nonreinforced stimulus is seen in the lower curve of Fig. 7.14(b).

AUTONOMIC CONDITIONING

You have already seen that the autonomic nervous system can be classically conditioned by the use of a neutral CS paired with aversive stimulation. In more recent years it has become apparent that the ANS can also be instrumentally conditioned, i.e., given some reinforcement which is contingent upon a particular autonomic response, subjects can be induced to make that response in order to bring on the reinforcement.

In one set of studies DiCara (1970) reports that rats would increase or decrease their heart rates when the change in rate was followed by stimulation of a "pleasure center" of the brain. In other studies intestinal relaxation or contraction could be conditioned instrumentally (Figure 7.15).

SCHEDULES OF REINFORCEMENT

In the examples given so far, reinforcement was given after every response. There are other ways to effect it, however, and some interesting changes in the pattern of bar presses can be seen when intermittent, rather than continuous reinforcement, is used. There are several possible schedules for delivery of reinforcement. In one type of schedule the reinforcement depends on the number of responses emitted by the animal. A *fixed ratio* (FR) schedule provides for reinforcement after a given number of responses, and the number of responses per reinforcement is given by a number after FR. The continuous reinforcement schedule described above is an FR 1 schedule because only one response is required for each reinforcement. An FR 10 schedule would require 10 responses before delivery of reinforcement, etc.

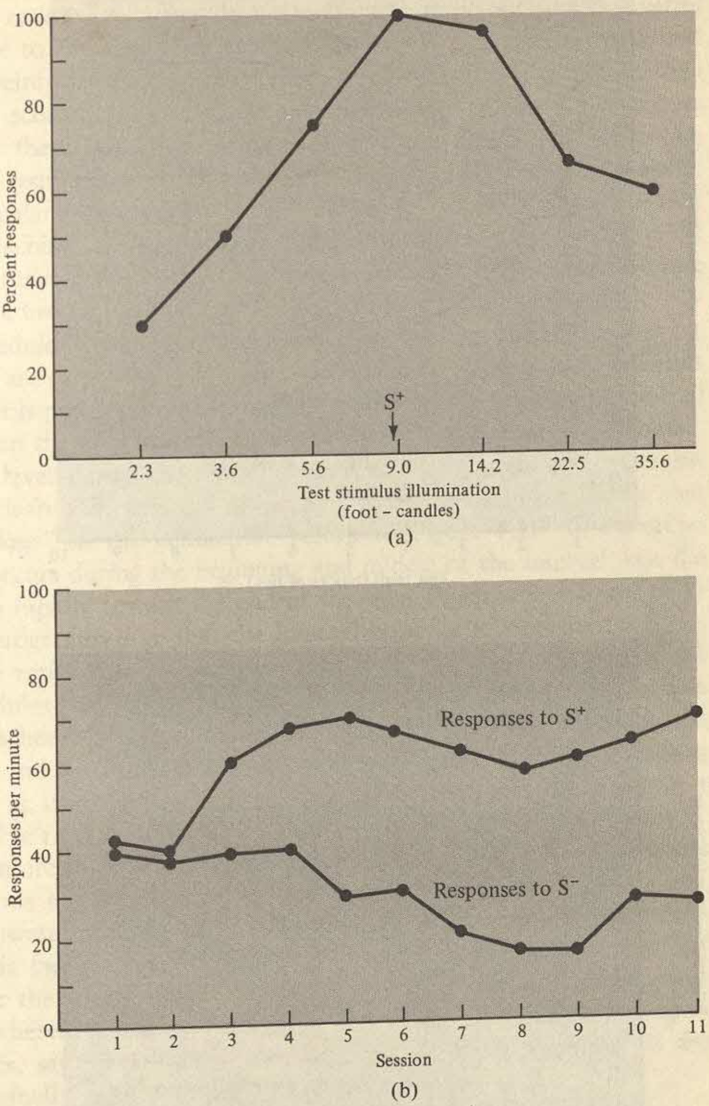


FIGURE 7.14

Operant generalization and discrimination. (a) Pigeons were trained to peck a key illuminated with 9.0 foot-candles of light. They were tested with illuminations varying from 2.3 to 35.6 foot-candles. The curve shows the percentage of the number of responses given to the training stimulus (100 percent) that were given to each of the test stimuli. (b) Pigeons were reinforced for pecking when the key was illuminated with 9.0 foot-candles, (S+) and extinguished when the illumination was 22.5 foot-candles (S−). Note that over the course of discrimination training, the number of responses in the presence of the S+ increased, while responding in the presence of S− decreased. Redrawn from Richardson, 1969.

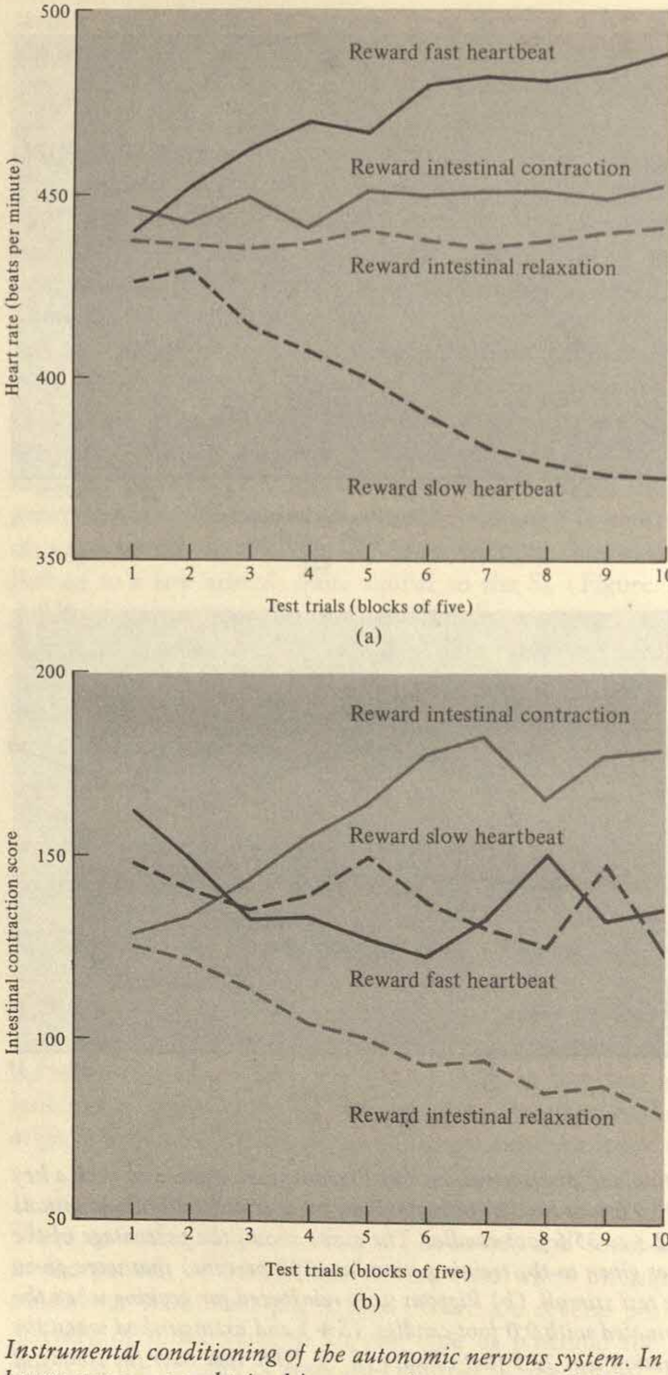


FIGURE 7.15 *Instrumental conditioning of the autonomic nervous system. In (a) the upper and lower curves were obtained from rats that were rewarded for increasing or decreasing their heart rates. The two middle curves show that other rats, who were rewarded for intestinal contraction or relaxation, did not show the same changes in heart rate. On the other hand, in (b), the rats rewarded for increasing (upper curve) or decreasing (lower curve) their intestinal contractions showed the expected increase or decrease, while the animals rewarded for changes in heart rate showed no such change in intestinal motility. In other words the conditioning procedure was specific to the response in question and did not result in a general increase in autonomic activity.*
From DiCara, 1970.

In a *variable ratio* (VR) schedule the number of responses required varies from response to response. For example, perhaps 5 responses are required for the first reinforcement, 10 more responses for the second, then 2, then 8, etc. A VR schedule is characterized by the average number of responses required over the course of a session in the Skinner box. A VR 10 would, for example, require on the average 10 responses, but the actual number for any particular reinforcement would vary from trial to trial around that value. Slot machines are set up to present reinforcement (money) on a VR schedule; fortunately for the slot machine operators, a high and steady rate of behavior is usually obtained with this schedule.

Other schedules are primarily controlled by the time since the last response; they are called *interval* schedules. In a *fixed interval* (FI) schedule reinforcement is postponed for a given interval after the previous reinforced response. Then the next response after the end of the interval is reinforced. Pressing the lever during the interval between reinforcement is of no avail. Animals can learn that responding during the interval is of no use, as seen in the "scallops" in the cumulative record of Figure 7.16. Little or no responding occurs during the beginning and middle of the interval, but the rate picks up rapidly toward the end of the time. A *variable interval* (VI) schedule is programmed so that the interval between reinforcements is not constant but varies from reinforcement to reinforcement. Examples of VI and FI schedules that you are probably familiar with include having a quiz at regularly scheduled intervals (note the similarity between cramming the night before and the FI scallop in the record in Figure 7.16) versus having pop quizzes at irregular intervals (which theoretically should result in a high and stable rate of studying).

When reinforcement is terminated, the course of extinction is different for the various schedules. Extinction is fastest with continuous reinforcement and slowest on the VI and V schedules. An anthropomorphic interpretation of this fact is that it takes longer in the case of the VI and VR schedules for the animal to find out that the reinforcement device has been turned off, whereas it knows immediately for the FR 1 schedule. For higher FR schedules, say 40 or 50, it takes at least as many responses as the schedule originally required to find out that the reinforcement is off.

BEHAVIOR TECHNOLOGY

In recent years the use of techniques of shaping and other principles developed in the study of operant conditioning have been extended well beyond the laboratory rat in the Skinner box. Some of the applications of operant technology will be described in Chapter 18, in which various methods of treatment of behavior disorders will be discussed. Other applications have been found in the field of education, as illustrated on pages 205–207.

Aversive Learning

In aversive conditioning, the aim is to induce the animal to perform some activity to prevent (avoid) or to terminate (escape) a painful or otherwise noxious stimulus. The reinforcement for such behavior is called *negative reinforcement* because its removal increases the likelihood of that behavior's

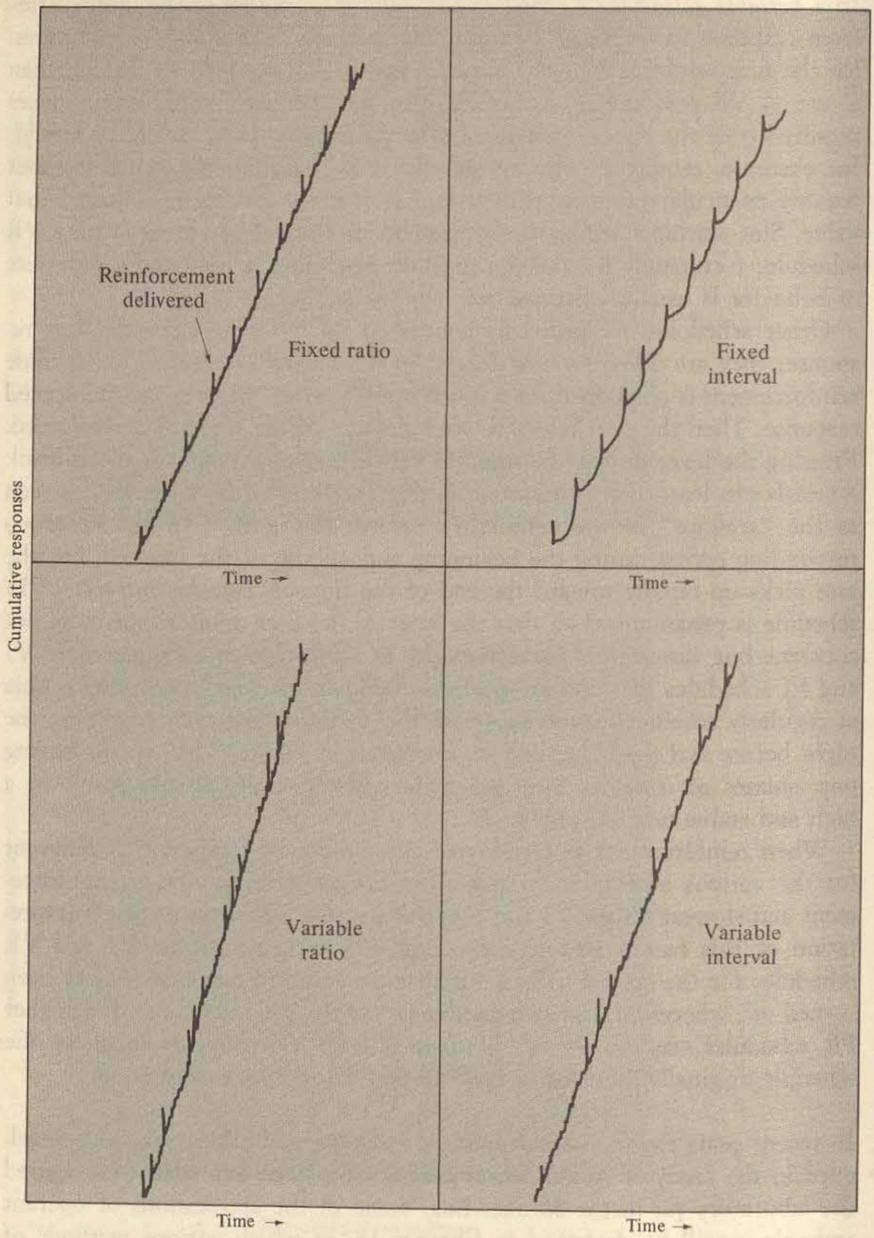


FIGURE 7.16 *Hypothetical cumulative response records obtained with various schedules. The presence of a reinforcement is indicated by the vertical mark on the record. In the FR schedule, the reinforcement occurs after a fixed number of responses. Note the scallop in the FI record caused by the animal's pausing after each reinforcement and then responding rapidly at the end of the interval. Behavior with the VR and VI schedules is similar. A high and steady rate is obtained for both. The reinforcements, however, depend upon the number of responses with the VR schedule and upon the interval between responses with the VI schedule.*

Programmed Instruction

In recent years a number of innovations have been made in the technology of teaching, for the most part based upon what psychologists have learned about the conditions unders which learning is best. The principles exploited are these: (1) The learner should proceed at his own pace. If he is faster than his fellow student, he can move ahead, rather than risk the boredom of dragging behind. On the other hand, if he is slow, he can take the time necessary to master the material without holding others back. (2) The learner is actively involved in the process of learning. He tests himself, determines his own performance, and decides when to move on. (3) Learning takes place in relatively small steps, each of which is well worked out and logically related to the previous step. In this way logical gaps, requiring a "leap of faith" may be held to a minimum. (4) Immediate knowledge of results is provided so that the learner knows at once whether he has made an error or not and can take immediate steps to correct it, rather than persist incorrectly.

How are these principles applied in education? Actually, there are at least three ways. First of all, there is the programmed textbook. *The material is arranged in small steps, with frequent questions. The reader covers the answers, which are found in the margin, and corrects himself as he goes. A sample from a programmed text appears on the next page.*

Another device for programmed instruction is the teaching machine. It is actually quite similar to the programmed text, except that the material, questions, and answers, are displayed by a machine. The subject's answer to each question may be recorded so as to automatically advance to the next "frame," containing either new material or a test question. An advantage of the machine is the possibility (also possible with the text, but somewhat clumsy) of branching programs, *in which the learner's response to a test question determines the direction in which he proceeds next. For example, an incorrect answer may result in the repeat of a previous few frames, or it may lead to a new set of frames in which remedial work is provided. A correct answer, on the other hand, may permit moving ahead, or perhaps skipping some intermediate material. Teaching machines may be quite simple, consisting of cardboard inserts fit into a rather inexpensive plastic box with windows that can be covered or opened by the operation of a response key; or they may involve the use of a random access slide projector (from which you can select any slide at any time, rather than only in sequence) together with sophisticated electronic programming equipment which records the learner's answers and determines which slides to be presented next.*

The most sophisticated form of programmed instruction employs digital computers. The learner "talks" to the computer by means of a terminal with a keyboard and perhaps a cathode-ray-tube display for presenting informa-

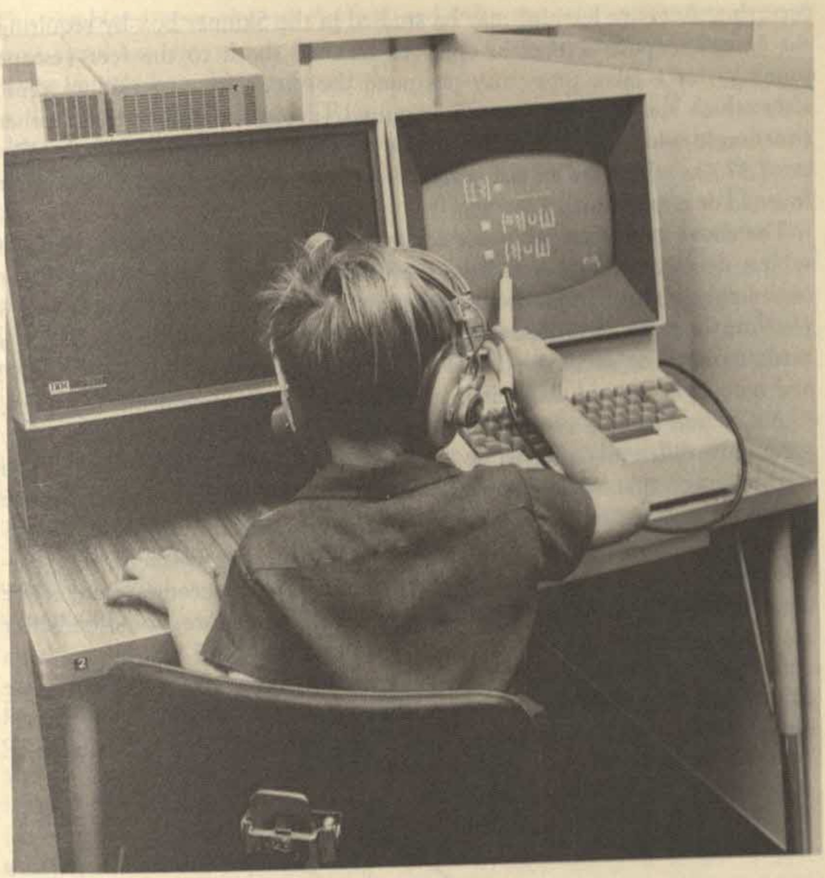
Introduction to Operant Conditioning

Estimated time: 8 minutes

Turn to next page and begin

Reinforcement and behavior occur in the temporal order: (1) ____, (2) ____. 7-5	(1) behavior (2) reinforcement 7-5
If an animal's response is not followed by reinforcement, similar responses will occur ____ frequently in the future. 7-10	less (in-) 7-10
Food is not reinforcing unless the animal has first been * * * food for some time. 7-15	deprived of (without, hungry for) 7-15
In laboratory research, various devices are used to reinforce responses. Heat can be used to ____ the responses of a cold animal. 7-20	reinforce 7-20
The response of pressing a bar must be emitted at least once in order to be ____. 7-25	reinforced 7-25
No eliciting stimuli are observed for bar pressing, flicking leaves in the park, etc. Therefore, responses of this type * * * classified as reflex behavior. 7-30	are not (cannot be, will not be) 7-30

From Holland & Skinner, The Analysis of Behavior, *New York: McGraw-Hill, pp. 41–42.*



From Suppes, 1966. Photo by Fred Kaplan from Black Star.

tion to him (see the preceding figure). The potential for these machines is quite great, in view of the tremendous flexibility of the digital computer. A whole college curriculum could be stored in its various memory structures, and courses taken at the convenience of the student.

There are other, more far-reaching possibilities for computer-aided instruction. Thus, because of the capacity of modern machines it is possible that each learner could be diagnosed according to the ways that he or she can learn best, areas of difficulty, etc., and carefully prepared programs run through which would represent the best and most efficient way to proceed for that *student. However, although the* machine *capacity could handle such an effort, we do not, unfortunately, have the knowledge about individual differences in learning that would permit such a development (Martin, 1970). Therefore, at present, the computer is simply a big, expensive teaching machine that adds much in the way of storage capacity but little in the way of educational expertise, over and above that offered by the teaching machine.*

occurring. Aversive learning may be studied in the Skinner box by requiring the animal to push a lever in order to turn off shock to the feet (escape training), or a lever press may postpone the shock for a period of time, after which another lever press is required (avoidance training). Another situation in which aversive learning may be studied is the shuttle box (Figure 7.17) in which the animal is required to run from one end to the other to avoid or escape shock.

The above avoidance habits are *active*, in that shock will come unless the subject does something. Avoidance may also be *passive*, in that the subject can simply refrain from doing something (e.g., climbing down from a platform onto an electrified grid floor, or not touching a hot stove or a rattlesnake). The aversive stimulation in such a case is called punishment, and more will be said about it in the section on reinforcement.

Active and passive avoidance habits reflect different processes, and they seem to be differently affected by damage to parts of the limbic system. You might expect that some tasks and animals would produce better active avoidance, while other combinations would produce better passive avoidance. If an animal's tendency in an aversive situation is to freeze, then passive avoidance will be easier. However, an animal who becomes more active during punishment or who has a strong tendency to explore would be better at active avoidance. The reason for this difference should be obvious from what has gone before. If the animal's natural behavioral tendencies are more nearly compatible with the response to be learned, then learning will surely be easier than if an incompatible response must first be eliminated.

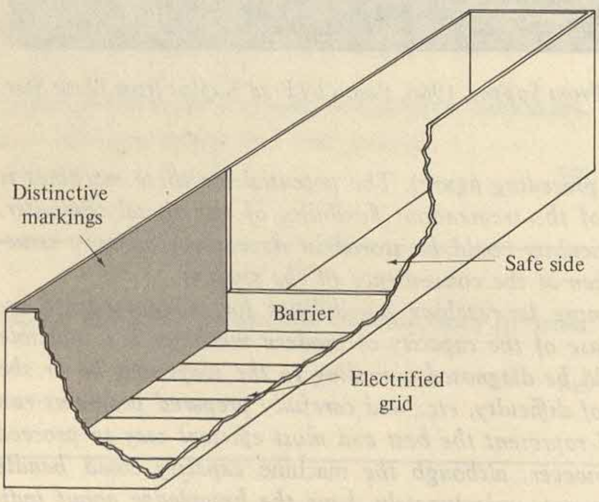


FIGURE 7.17 *Diagram of a shuttle box as might be used in an avoidance learning experiment. The animal is placed in the side with the electrified grid and must cross the barrier to the safe side within a specified time limit or be shocked. The shock and the safe sides are usually marked in a distinctive fashion.*

RELATIONSHIP BETWEEN CLASSICAL AND INSTRUMENTAL CONDITIONING

The combined operation of classical and instrumental conditioning is seen most clearly in the case of aversive learning. Consider, for example, the rat in the shuttle box. It is assumed that the aversive stimulus, electric shock, is a UCS, for which the UCR is fear. (Note that the UCR is internal, although it may also have external manifestations such as crouching, urinating, defecating, etc.) Other stimuli present in the situation, such as the box, the lever, etc., are, of course, present at the same time as the UCS, and therefore, they may become conditioned stimuli for the CR of fear. As you will see in Chapter 12, fear is not only a CR, but is also a motive and as such induces the animal to make an instrumental response in order to reduce it. Fear reduction is thus the goal to be attained through the avoidance response. In other words, the motive responsible for the avoidance response is itself a classically conditioned response.

There is also some indication that the same kind of process operates in the conditioning for some positive goal, e.g., lever pressing for food. One can conceive of the food as a UCS for a positive internal response (hope?), which becomes classically conditioned to the box, the lever, etc.

In other words, one can consider that in both appetitive and aversive conditions what is classically conditioned is an expectancy about the consequences of the situation, which, in turn, leads to the appropriate behavior.

Reinforcement, Learning and Performance

THE LAW OF EFFECT

In the situations described previously learning occurs when some reward, or reinforcing stimulus, or incentive, or goal, depending on which words you prefer to use, was present at the end of the behavioral sequence to be learned. Now the question is exactly what role does the reinforcement play in the learning process? Is reinforcement necessary for the establishment of a new habit? Does it simply help matters by affecting such things as how closely one pays attention to the task or how strongly one performs a certain behavior that has already been learned? Years ago Thorndike (who, you will recall, used the puzzle boxes) suggested that behavior which led to a satisfying state of affairs was "stamped in," whereas behavior which led to an annoying state of affairs was "stamped out." This proposal was called the *law of effect,* and has played a major role in almost all subsequent attempts to understand the learning process. Psychologists of one persuasion maintained that reinforcement was necessary for the establishment of a habit, while others said that reinforcement had no effect on *habit per se* but only appeared to do so because of its facilitatory effect on *performance.* There is, of course, hardly any one who maintains that reinforcement does not affect performance. There is certainly abundant evidence, such as the controlling effect of schedules of reinforcement on behavior, that this is so. However, the problem has been to devise a situation in which learning and performance might be separated.

Several experiments have demonstrated so-called *latent learning,* in which it appears that learning and performance were indeed separated. Tolman and Honzik (1930), for example, allowed hungry rats to explore a maze

but did not put any food in the goal box. These animals presumably learned something during their nonreinforced exploration because, when reinforcement was later introduced, they learned the maze faster than a group of control animals that had not had the exploration first. At this point it is questionable whether the animals that explored were truly nonreinforced, because more recent work indicates that exploration itself may be a strong motive. The whole issue of motivation which, of course, is quite crucial to a thorough understanding of reinforcement, will be taken up later in Chapter 12.

THE KNOWLEDGE OF RESULTS

The law of effect, whether or not it applies to learning per se, concerns primarily the hedonic effects of reinforcement, their consequences for pleasure or pain. Reinforcement also, however, serves an *informative* function. It provides information about the correctness of the previous response. The development of learning sets, for instance, is dependent upon the information, provided by reinforcement, as to the correctness or incorrectness of the immediately preceding response. Even mild electric shock, normally a negative reinforcer, can serve as positive reinforcement for human subjects if it signals that a response was correct. A great deal of human learning depends upon this informative effect of reinforcement and is essentially indifferent to the hedonic tone, at least for mild reinforcements. More will be said about the effect of knowledge of results in Chapter 9.

THE PREMACK PRINCIPLE

Our concept of reinforcement has been broadened considerably by some recent work by David Premack (1965). To understand reinforcement, Premack maintains, you must first of all have some idea about the behavioral repertoire of the animal in the particular situation in question. How does the animal behave when it is in the experimental situation and no reinforcement is being delivered by the experimenter? With food, water, etc., freely available, what does an animal do? Premack studied rats in just this way, counting the occurrences of various kinds of behavior over the course of several days. Behaviors might include grooming, eating, drinking, running (in an activity wheel), etc. He found that in any particular situation certain behaviors were performed more often and for a longer period of time than others, and he was thus able to rank various behaviors in a hierarchy based on their probabilities of occurrence. Remember that, up to this point, the animal was free to perform any of the behaviors at any time; it was under no constraints imposed by the experimenter.

Premack's next step was to manipulate the behaviors by requiring one behavior to be performed before another one could be performed. For example, a rat might be required to groom before being permitted to eat or to drink before being permitted to run in the activity wheel (the running was controlled by locking or freeing the wheel). He found that the probability of an *infrequent* behavior could be raised by *requiring it to be performed before a highly probable behavior would be allowed.* In other words, providing the opportunity for a highly probable behavior to occur serves as reinforcement for a behavior with lower probability.

One may still wonder what it is about performing highly probable behavior that is reinforcing, and whether or not stimuli associated with the high probability behavior (e.g., the food associated with the high probability behavior of eating) have something to do with the reinforcing effect. However, Premack's principle does state the conditions of reinforcement in rather broad behavioral terms, and without having to identify or define "satisfying" and "annoying" states of affairs. The probabilities of various behaviors can be objectively determined, while the satisfyingness or annoyingness of stimuli cannot, so the principle is quite appealing to behavioristically oriented psychologists. (To be fair to Thorndike, it should be noted that he took great pains to specify behaviors indicative of a satisfying or an annoying state of affairs. However, the subjective reference of the terms is still there.)

ELIMINATING UNDESIRABLE BEHAVIORS

As implied above, there are two ways to eliminate undesirable behaviors. First of all, it is possible to *extinguish* a particular behavior by withdrawing the reinforcement for it (or, to use Premack's principle, to remove the contingency whereby the behavior in question is tied in with a high probability behavior). Second, it is possible to use passive avoidance conditioning and *punish* the behavior when it occurs.

Which of these two alternatives is preferable? Ideally, they both should be used, but the overall success will depend on several factors. It depends on how strongly motivated the undesirable behavior is and how the reinforcers are related to each other. Extinction alone is quite effective in simple situations. For example, it is rather easy to extinguish a bar-pressing response by a rat if the reinforcement is withdrawn, since both the response and the reinforcement can be identified quite accurately and consistently, and the reinforcement is absolutely under the experimenter's control. Real-world situations with human beings are somewhat more messy, however, in that one is never quite sure what reinforcement is maintaining a particular undesirable behavior and whether or not punishment is also positively reinforcing. Take, for example, aggressive behavior on the part of one child toward his or her brother or sister. Is it being maintained by the reinforcement of seeing the victim hurt or crying and agitated, or is it maintained by the mother's intervention, which may be regarded as a form of "paying attention" to the aggressor? Withholding reinforcement would probably eliminate the undesirable behavior but how is it to be withheld? Punishment might seem to be a more desirable and workable alternative in this case, but the punishment itself may also be positively reinforcing.

Laboratory experiments on the effects of punishment have avoided this dilemma by controlling for the various sources of reinforcement. The results, in general, indicate that punishment can effectively eliminate particular behaviors if the following conditions are met (Azrin, & Holz, 1966): (1) *The punishment must be strong.* Weak punishment only serves to prolong the extinction process, while strong punishment will have an immediate effect. There is even some evidence that weak punishment will desensitize the subject to effects of strong punishment later, making the problem more difficult

to solve than if *no* punishment had been delivered. (2) *The punishment must be consistent.* It must be delivered each time the undesirable behavior occurs and not delivered when it does not occur. Furthermore, every undesirable response should be punished. If a response is sometimes punished and sometimes not, then it will not be as easily eliminated. (3) *Punishment must be delivered immeditately after the response has occurred.* Delay of punishment will reduce its long-term effectiveness. Some parents wait to spank a child until they are no longer angry, because they believe that punishment should not be delivered in anger. This procedure probably weakens the effectiveness of the punishment, making the behavior persist longer than necessary. (4) Punishment is more effective if the *behavior to be eliminated is not too strongly motivated.* While punishment may work in such situations, the combination of strong motivation with strong fear of punishment can produce some undesirable side effects in the form of conflicts. (5) If the behavior is highly motivated, then punishment will be more effective if *some acceptable behavioral alternative to the undesirable one is provided.* (6) The punishment should always be *coupled with the withdrawal of positive reinforcement for the behavior in question.* This is sometimes quite difficult to accomplish, as suggested in the example given above, since the punishment itself may also be a form of positive reinforcement. Clearly, situations like the one described tax the creativity, as well as the patience, of parents of small children.

Theoretical Issues

The study of learning has led to a number of differences of opinion about the process. These differences are reflected in different theories of learning and in different ways of discussing the facts of learning. You have already encountered a discussion of the role of reinforcement (i.e., whether it is responsible for establishing the habit to begin with or whether it simply facilitates performance). You have also seen something of the issue of insight versus trial and error in learning: whether learning involves a sudden, insightful reorganization of the way a problem is perceived, or whether it proceeds through a more or less automatic process of trying first one thing and another. At this point it seems worthwhile to introduce two additional theoretical issues, both of which are of importance in understanding learning: cognitive *versus* S–R (stimulus–response) formulations, and continuity *versus* discontinuity. You will see that they intersect in important ways with the reinforcement and insight issues.

Cognitive Versus Stimulus–Response Approaches

What happens when learning occurs? One approach is to understand the process as the establishment of a connection, or link, or bond, between a stimulus on the one hand and a response on the other. The bond, or habit, becomes established when the stimulus and response occur together in time. The result is that, given the stimulus, the response will occur. Whether or

not reinforcement is necessary for the bond to be established is another theoretical issue. The main point, however, perhaps best seen in the theory presented by Clark Hull (1943, 1951), is that the S–R bond is the basic unit of habit. All habits, it is argued, can be reduced to elementary relationships between stimuli and responses.

Another approach is to understand learning as a process of developing an internal representation, or "map" of the environment, including the reinforcement contingencies as well as stimuli that signify reinforcements. The map may perhaps be viewed as a pattern of associations among stimuli, i.e., S–S associations, together with a representation of appropriate behavior in relation to the stimuli. This approach is called "cognitive," because of its focus upon internal representations, and the obvious relationship between these concepts and the concepts of thinking and reasoning. The learning of *specific responses* is deemphasized in this approach, whereas the learning of a general plan is stressed. Perhaps the name most closely associated with this approach to learning is Edward C. Tolman, who wrote a book entitled *Purposive Behavior in Animals and Men* (1932) as well as many later papers in which this view was expounded.

Continuity Versus Discontinuity

When learning occurs, does it proceed gradually, with a more or less continuous increase in the strength of a habit (e.g., with increasing numbers of trials), or does it occur in steps, in which there is more or less a discontinuous change from one state to another? To put it differently, can there be varying degrees of habit strength, or is a habit an all-or-none phenomenon—either it exists or it does not, with no stages in between? The continuity approach, exemplified by the approach of Hull mentioned above, considers that habits can vary in strength, and that strength is increased by practice, as long as there is reinforcement present. The discontinuity approach, on the other hand, assumes that whatever is learned acquires its full strength as a result of a single trial. Most complex habits are considered to consist of many components, however, each of which is learned in an all-or-none fashion. Thus, even though it *appears* that a habit is increasing in strength gradually (e.g., note the gradual increment in responding typified by the learning curve discussed earlier in this chapter), what is actually happening is that the *components* of the complex habits are being acquired in an all-or-none manner. However, only a few of the components can be acquired in a single trial. It may take many trials for all of the components to be learned, and the gradually increasing curve is the result. Therefore, regardless of the gradual shape of the learning curve, the basic process underlying learning is essentially a discontinuous one. This approach was popularized by Edwin R. Guthrie in the 1930s and 1940s, and later by W. K. Estes at the University of Indiana.

Neither of these issues may be considered resolved, and it is unlikely that critical research demolishing one or the other will be forthcoming in the near future. At this point you should consider them simply as alternative ways of conceptualizing the learning process. Each orientation has some data

that support it and some that tend not to support it. Ultimately, perhaps, someone will develop a conceptualization that encompasses both approaches.

Summary

Learning is defined as a relatively permanent change in behavior, and the definition excludes behavior changes that might be termed adaptation or habituation, as well as changes in performance caused by changes in motivation, arousal, etc. The two broad classes of learning are *classical conditioning* and *instrumental learning*.

In classical conditioning a neutral conditioned stimulus, the CS, comes to evoke a conditioned response (CR) when it is paired with an unconditioned stimulus (UCS) that naturally evokes an unconditioned response (UCR). Reflexes that can be conditioned include salivation, the eye blink, and the galvanic skin response. In acquisition, the strength of the CR increases with increasing numbers of trials in which the CS and UCS are paired. When the UCS is removed, the CR *extinguishes*, i.e., diminishes. After a rest period *spontaneous recovery* may occur, which is a partial recovery of CR strength. The CR initially *generalizes* to stimuli that are similar to the CS, but with *discrimination* training, in which responses to the other stimuli are extinguished, the CR may be given only to the original CS. If the discrimination is made too difficult, however, *experimental neurosis* may occur. In *higher-order conditioning* a second CS may, by pairing it with the first CS, also come to evoke the CR. Classical conditioning has on occasion been thought to be the basis for complex learning, and has recently been shown to be the basis for learning certain kinds of emotional responses.

Response learning has been studied by putting animals into boxes in which they had to find their way out, or by requiring the construction and/or use of some kind of tool to reach a goal.

Maze learning has been studied in a variety of animals, and has been used to investigate pattern learning, and thinking, as well as the effect of various motivational and practice factors in learning.

In *discrimination learning* the animal must learn which of two or more stimuli is correct (i.e. rewarded). It is the basis for studies of perceptual discrimination in animals and nonverbal humans. Animals may develop *learning sets*, in which they become more and more efficient in solving discrimination problems.

One form of instrumental learning is *operant conditioning*, in which the response is *emitted* by the animal, rather than evoked by the CS. *Reinforcing* a response (e.g., with food) increases the likelihood that it will be emitted, and is the basis for this kind of learning. Complex *chains* of behavior may be *shaped* by reinforcing successive approximations to the desired behavior, always beginning with a response that is in the animal's repertoire. Different *schedules of reinforcement*, based upon either the time since the last response

or the number of responses emitted, will produce different patterns of responding. A *discriminative stimulus* can come to exert control over the animal's behavior if the response is reinforced in its presence and not when it is absent. There are a number of recent applications of operant conditioning principles, including classroom management, behavior modification therapy, and programmed instruction.

In *aversive learning* the animal is taught to escape or to avoid a punishing stimulus. Successful avoidance depends upon the classical conditioning of fear and then instrumental conditioning of a response to reduce the fear.

Reinforcement is a major factor in learning. The *law of effect* states that learning depends upon reinforcement. One form of reinforcement that is effective in humans is the *knowledge of results,* which is quite important in the learning of skills. The *Premack principle* states that the opportunity to perform behaviors that the animal is quite likely to emit in a free situation (high probability behaviors) can serve as reinforcement for low probability behaviors. Negative reinforcement is effective in inducing an animal to learn some response to avoid a negative stimulus. *Punishment* is effective in passive avoidance learning, i.e., in eliminating undesirable behaviors. It works if it is strong, consistent, and immediate, and if the behavior to be eliminated is not strongly motivated, if an alternative behavior is provided, and if there is withdrawal of reinforcement for the undesirable behavior that is coupled with the punishment.

In addition to the theoretical issue of whether learning occurs by insight or by trial and error, and whether reinforcement is necessary for learning, there are two other major issues: (1) Is the basic unit of learning a stimulus–response bond or an internal representation of a stimulus situation, and (2) Does learning proceed in a continuous or an all-or-none fashion?

Selected Readings

Marx, M. H. (Ed.) *Learning: Processes.* New York: Macmillan, 1969.

Pavlov, I. P. *Conditioned reflexes.* New York: Dover, 1960.

Human Learning and Memory: Verbal Skills

8

Think for a minute of the kinds of learning that are impotrant in your life. As a student, you are no doubt aware of the profound importance of learning verbal material. In fact, you are probably so involved with verbal learning that sometimes you wish it were not so prevalent. Fortunately or unfortunately, as the case may be, the human organism has evolved in such a way that a primary means of communication with other humans is through language. It is one of our prime biological capacities, and we use it a great deal.

Another phenomenon you are well acquainted with is memory, or perhaps its absence on certain occasions. Many people, particularly students, feel that if they could just remember everything they learned, life would be almost perfect. Forgetting, however, is a fact of life, and if it cannot be eliminated, at least it can be understood. Maybe you will also come to see that it is quite helpful on occasion.

Psychologists are interested in verbal learning and memory for a number of reasons. First, understanding verbal learning can be seen as a way to understand the formation of *associations.* You will recall from Chapters 1 and 7 that associationism as a philosophical school of thought (which developed the notion that knowledge is a product of the association of ideas) was an important forerunner of psychology, and some of the techniques for study of verbal learning processes were developed by Hermann von Ebbinghaus in order to understand the establishment of associations. Many of the investigators of verbal learning have followed in that tradition—they are primarily interested in associations. Second, psychologists have studied verbal learning and memory as a means of getting at the way people *organize* their experiences, especially the way that memory is organized. Third, there is the practical side of the question. *Mnemonics*, or the practical art of memory,

has been developed by numbers of people interested in the subject; in recent years psychologists have also become interested in how people such as professional mnemonists can perform their feats of memory.

In the previous chapter you encountered the distinction between learning and performance. That is, learning must be inferred from performance, but changes in performance do not necessarily reflect changes in learning. A similar distinction must be made here. The special kind of performance of concern is *retention.* The distinction is that evidence of learning (acquisition) is always given by some kind of performance that occurs after the learning experience, i.e., by a retention test. A failure of memory may indicate a failure of acquisition, or it may be that the material was learned but, for some reason, was not available at the time of test. Keep this distinction in mind as you read this chapter. It should not be too hard to do, because most students, after taking a test, find themselves making reference to the distinction by saying "I *knew* that, but I couldn't remember it!" You have probably had the answer to a question suddenly pop into your mind just as you were handing in the test.

One additional point must be made before proceeding: None of the kinds of learning mentioned in this chapter really involves learning completely *new* material. So-called new learning is often a matter of reorganizing old learning, just as an operant response, no matter how complex, is shaped out of components that are already in the animal's repertoire. Ebbinghaus, who conducted the first experiments in verbal learning, recognized that most learning was complicated by the effects of past experience, particularly as it affected the meaning of the material learned. Consequently, he devised some material that he thought was relatively devoid of meaning and used that in his studies. The item he invented was the "nonsense syllable," which is two consonants with a vowel in between (e.g., XOB, YUF, etc.). As it turns out, such material is not all devoid of meaning, in that you can usually come up with an associate of the syllable, i.e., something that it reminds you of. Also, the items are constructed out of familiar components, letters, which are simply organized in relatively unfamiliar ways. These phenomena are known as transfer of training, which is another term used to refer to the effect of old learning on new learning. It is an extremely important aspect of all learning, and will be discussed in more detail in a later section.

Before proceeding with this chapter you need to be aware that the whole area of verbal learning is in somewhat of a state of flux, and, as is the case in some other areas of psychology, there are several different schools of thought about the phenomena in question. In this area the major differences are perhaps to be found between psychologists who have recently come under the influence of developments in linguistics and who approach verbal learning as a special problem in cognition (See Chapters 10 and 11), and more traditionally oriented psychologists who, following Ebbinghaus, seek to understand the process in terms of its elementary components, often considered as associations between stimuli and responses. This chapter will, for the most part, focus upon the more traditional approach and some of its

more modern developments, while language and cognition will be dealt with in Chapters 10 and 11.

Types of Verbal Learning

Most of the verbal learning you do can be described as one of three basic kinds of learning. They are *serial learning, paired associate learning,* and *free recall learning* or *event learning.* They differ in terms of the task required and may also reflect the operation of different processes, although we will not make too much of the latter point.

Serial Learning

Serial learning occurs when you have to memorize a list of items and recall them in a particular order. A history student learning the series of events leading up to, say, the Franco-Prussian war must at least partly engage in serial learning. A medical student memorizing the names of 12 cranial nerves (nerves that leave the brain above the level of the spinal cord) must engage in serial learning. Memorizing a poem or a prose passage is another good example. The words must be remembered in order. In experiments serial learning may be studied with lists of words, numbers, or nonsense syllables, in which the subject's task is to learn the list so that he can give the items back in the correct order.

Paired-Associate Learning

In paired-associate learning you must learn what goes with what. When you meet someone for the first time, you probably try to learn that person's name so that when you see him again you will be able to call him by name. This is an example of paired-associate learning. There is a *stimulus item,* which, in this case is the person himself; and there is a response item, his name. The problem is, given the stimulus item, to come up with the correct response. Another example of paired-associate learning is the learning of the vocabulary of a new language. You must learn that *fenêtre* means "window" in French, etc., so that when you see the stimulus term (*fenêtre*), you will be able to come up with the response term (*window*) and thus translate whatever you are reading.

In experimentation, lists are often constructed of nonsense syllables, words, or numbers, in which one item of each pair, the response, must be given whenever the stimulus item appears. A sample list is shown in Table 8.1.

Free Recall Learning

Free recall learning is like serial learning, in that a list of items must be learned. However, the order in which they are recalled does not matter. The learner simply has to organize the material as best he can so that everything is remembered, but it makes no difference which item comes first, second, etc. Remembering a grocery list is a good example of this kind of memory.

TABLE 8.1 *Examples of materials used in paired-associate learning*

Stimulus	*Response*
RUJ	*FON*
PEL	*HIN*
QIJ	*WEF*
NEQ	*YOJ*
LEC	*MAV*
GEB	*HOV*
TUC	*TOL*
VAD	*BOK*
GIX	*DAT*
KUZ	*ZAN*

Much of the learning you do when you read a textbook for its content is also of this sort. The items to be remembered are the major ideas developed. While the logic of a particular argument may dictate the order in which the points are organized, it is the logic and not the sequence per se that is important. Quite often the good learner will impose his own order on the material; in other words, he will *organize* the material himself, and his order of recall will, of course, reflect his own organization and not necessarily the order in which he encountered the material. Since the learner is essentially unconstrained as regards recall order, free recall has been used as a method for studying the ways in which learners organize verbal material. More will be said about this point later.

Factors Affecting Ease of Learning Verbal Material

Some kinds of material are easy to learn, some are difficult. You have probably found that some kinds of conditions seem to foster learning, while others seem to inhibit it, and some strategies that you adopt in learning may work better than others. Also, some people learn better than others. In this section we consider some of these matters.

Effect of Type of Material

MEANINGFULNESS

One of the first facts that Ebbinghaus discovered in his studies of memory was that material that was meaningful was memorized more easily than nonmeaningful material. He memorized several stanzas from Byron's poem, *Don Juan*, and found that it was much easier than memorizing an equivalent amount of nonsense material, which, as you might expect, would be next to impossible. The meaningful material was also remembered for a much longer time.

Nowadays psychologists talk about meaningfulness in more specific and quantifiable terms than was possible at that time. Meaningfulness is usually

defined in terms of the number of associations produced by a subject when given an item as a stimulus. For example, the nonsense syllable MUV is not at all devoid of meaning, since it probably brings to mind such meaningful words as *mother, move, movie, mud,* etc. In general, the more associations evoked by material, the easier it will be to learn.

A more recent experimental approach has been to manipulate the *order of approximation to English.* Words chosen at random made up the zero order material, e.g., "Betwixt trumpeter pebbly complication vigorous tipple careen obscure attractive consequence expedition pene unpublished prominence chest sweetly basin awake photographer ungrateful." A fifth order approximation is "Road in the country was insane especially in dreary rooms where they have some books to buy for studying Greek." Miller and Selfridge (1950) used such material, having subjects recall it immediately after having been exposed to it one time. The results are shown in Figure 8.1. In general, the more nearly it approximates actual English, the better it will be learned and recalled.

IMAGERY

Another characteristic of verbal material that is important is the extent to which it evokes images in subjects. Material that has high imagery value is usually concrete in meaning, such as the word *dress.* Abstract words, like *freedom* do not tend to evoke images. Alan Paivio (1971) has shown that concrete material is learned more easily and remembered better than abstract

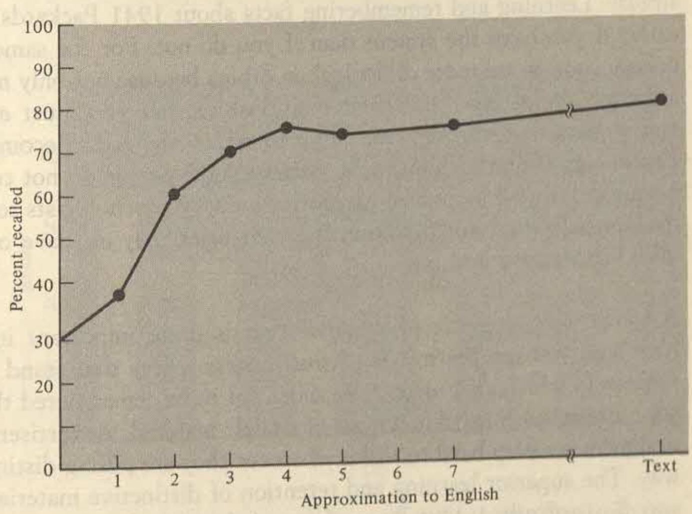


FIGURE 8.1

The more meaningful the material, the more easily it is learned and the better it is recalled. In this experiment subjects were exposed to one repetition of verbal material that varied in terms of its logical and grammatical structure from words chosen at random to actual text. They were tested immediately to see how much they could recall, and the curve shown is the result. Note that the more similar the material to English, the better it was recalled.
From Miller & Selfridge, 1950.

material, especially if the imagery can be used to express a relationship between the items to be learned (Figure 8.2). For example, if two items to be learned are "dress" and "dog," it is easy to imagine a dog with a dress on.

You may wonder whether there is any real difference between imagery and meaningfulness, since both are defined in terms of the tendency of words to evoke internal symbolic representations (images or verbal associations). Actually, the two are highly related. Paivio has shown, however, that most of the effect of meaningfulness on learning can be accounted for by imagery. Actually, the role that verbal associations and images play in learning of verbal material is the topic of a good bit of research at the present time, and we shall probably have a better understanding of how these factors are related in the future. You will see later that both of them play an important role in various techniques that have been developed as aids to memory.

CATEGORY RELATIONSHIPS

A third factor that is important is the extent to which the material to be learned can be related to conceptual categories. You have probably had the experience of seeing where some new item fits in terms of your own system of categories. If you happen to be an automobile fancier and you see a 1941 Packard, you will probably be able to "peg" it immediately in terms of its prestige value, appearance, its similarity to other cars of that era, etc. In other words, you already have a place for it in an internal system of organization that you might label "antique cars," or "luxury cars," or something similar. Learning and remembering facts about 1941 Packards will be much easier if you have the system than if you do not. For the same reason some college courses are more difficult than others because not only must you learn a certain set of facts and their relationships, but you must also develop a new system of categories according to which the facts become meaningful. Psychology is one such example, because most people do not come into such a course with the system of categories used by psychologists to describe and explain behavior. Furthermore, the categories they *do* have often interfere with learning the new ones.

DISTINCTIVENESS

A fourth characteristic of material that is quite important in determining how well you can learn it is *distinctiveness*. Ideas that stand out from the context in which they appear are more apt to be remembered than ideas that are more or less buried in a mass of similar material. Advertisers and product designers try very hard to make whatever they are selling distinctive in some way. The superior learning and retention of distinctive material is called the *von Restorff effect.* Von Restorff found that when she gave a subject a list of material consisting of pairs of different kinds of material to be learned in a paired-associate task, distinctive pairs were learned better. If a list contained, say, four pairs of nonsense syllables and four more pairs, such as a pair of geometrical figures, one pair of numbers, one pair of colors, and a pair of letters, then the dissimilar pairs would be learned and remembered better than the similar pairs. This effect occurred regardless of the type of material that was isolated. In other words, even nonsense syllables would

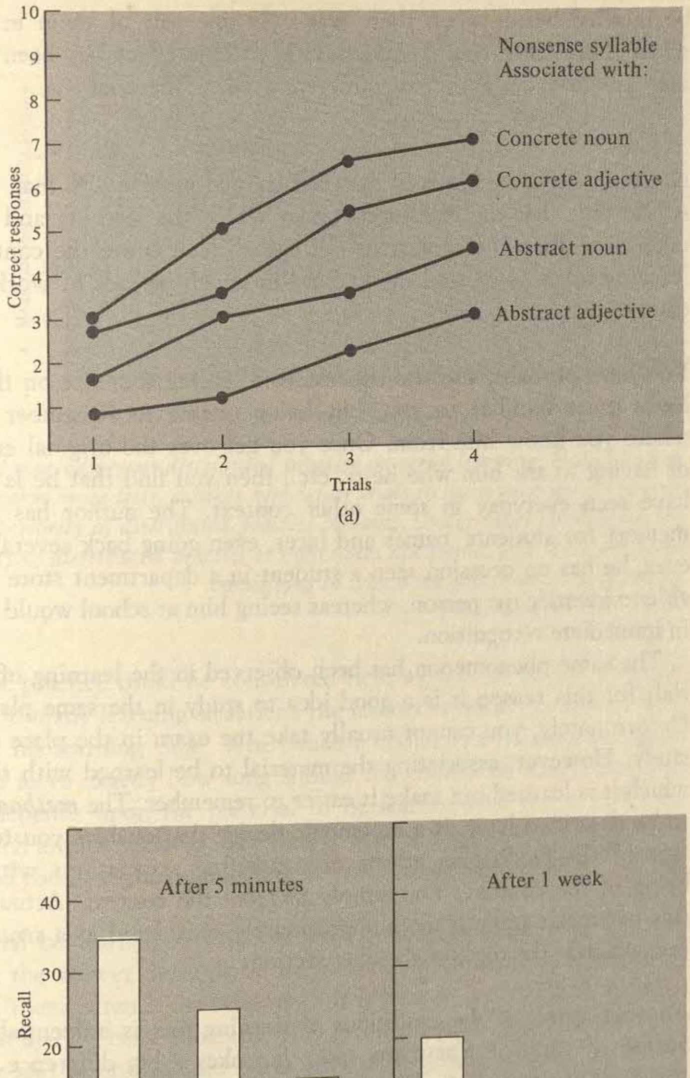


FIGURE 8.2

Learning and memory as a function of imagery. In (a) the graph indicates the progress of learning over four trials of nonsense syllables that were associated with a concrete, high imagery noun ("the QOF blister"), with a concrete adjective ("the rusty QOF"), with an abstract noun ("the QOF explanation"), and with an abstract adjective ("the basic QOF"). In (b) the recall of pictures (P), concrete words (C), and abstract words (A) is shown after two retention intervals.

From Paivio, 1971.

be recalled better when there was only one pair of them in the list than when there were four (Koffka, 1935). This effect has been repeated numerous times and with many different kinds of material.

Effect of Conditions of Learning

Not only are some kinds of material learned more easily than others, but it is also true that the conditions under which the learning and remembering take place are quite important. Two such factors are the context in which learning takes place, and the manner in which periods of work and rest are distributed.

SITUATIONAL CONTEXT

You have probably had the experience of seeing someone on the street who looks quite familiar to you, but being unable to remember his name or where you know him from. Once you get over the original embarrassment of having to ask him who he is, etc., then you find that he is someone you have seen everyday in some other context. The author has a fairly good memory for students' names and faces, even going back several years. However, he has on occasion seen a student in a department store and not been able to identify the person, whereas seeing him at school would have resulted in immediate recognition.

The same phenomenon has been observed in the learning of verbal material; for this reason it is a good idea to study in the same place each time. Unfortunately, you cannot usually take the exam in the place in which you study. However, associating the material to be learned with the context in which it is learned can make it easier to remember. The *method of locations,* to be described later, is a mnemonic device that enables you to take advantage of the facilitating effects of contextual associations without actually being in the context. You simply *imagine* the context. Actually, however, this particular topic is more appropriately considered as a *strategy* of learning, which is the topic of the next section.

DISTRIBUTION OF PRACTICE

Another aspect of the conditions of learning that is influential is the *distribution of practice.* For many tasks it makes a big difference whether you spend all of your allotted learning time at once or divide it up into smaller chunks separated by rest periods. Spending all of your time at once (i.e., "cramming") is called *massed practice,* while dividing up the time is called *distributed practice.* In general, a large number of experiments have shown that distributed practice is superior to massed practice. While the effect is somewhat greater for motor learning tasks (which are discussed in the next chapter) than for verbal learning, it is also seen in a number of verbal tasks such as serial and paired-associate learning. It seems that the more material there is to be learned, the greater will be the benefit of distributed practice. One experimental result is shown in Figure 8.3.

Effect of Learning Strategies

The way one approaches a verbal learning task is also quite important in determining how well the material will be learned and retained. In a sense

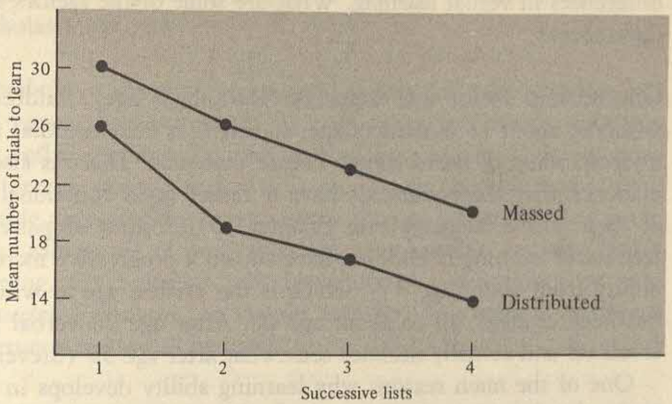


FIGURE 8.3

The effects of massed versus distributed practice on serial learning. Notice that as the learner learns more lists, it takes him fewer trials to learn each list. However, the superiority of distributed practice remains. Under other conditions, the superiority of distributed practice is sometimes not found, and there are some conditions in which massed practice is superior.
From Underwood, 1951.

distribution of practice could be considered here as well as in the previous section, since in many learning situations the learner is under control of how he distributes his learning time. When such a choice is available, the question may arise as to exactly how long should the chunks of study time be? The answer depends upon the material to be learned and raises two new questions which are interrelated. The first is that of *whole versus part learning*; the second concerns the establishing of *conceptual relationships.*

WHOLE VERSUS PART LEARNING

Should material be learned as a whole or should it be broken down into parts? Again, the answer depends on the nature and amount of material to be learned. If there is much material, then it is best to try to break it down into parts that are logically coherent. If a given piece of material seems to hang together and is broken into parts only with difficulty, then it should be learned as a whole.

You can regard conceptual organization of verbal material as a form of coding. You establish a code (i.e., a list of concepts or conceptual categories) that represents a larger list of items. It is easier to remember the code names than the individual items, since there are fewer code names; but the individual items seem to fit under the code names and, once the code name is recalled, the items (or at least a number of them) are recalled more easily.

Some strategies in learning have produced rather fantastic results; they described later in the section on mnemonics.

Individual Differences in Learning

Some people learn more easily than others, and a given individual may find some kinds of material easier to learn, while another person may find a different kind of material easier to learn. In other words, there are individual

differences in verbal learning. What are some of the factors related to these differences?

AGE

One obvious factor that influences learning is age. Children begin to use words at about 18 months of age, and there is evidence that they have some understanding of heard speech before that time. There is also a good bit of evidence that three-year-olds have a rather good functional understanding of their native language (see Chapter 10). Studies of paired-associate and free recall learning in children have shown a progressive increase in learning ability from about age 3½, which is the earliest age at which this process has been studied, up to about age 20. After age 20 verbal learning ability levels off and actually declines somewhat after age 50 (Stevenson, 1972).

One of the main reasons why learning ability develops in the early years is the development of efficient strategies for learning, including the ability to organize the material to be learned. Older children can make better use of the conceptual relationships present in verbal material, and as you would imagine, the more that is learned, the easier it is to use these relationships.

COGNITIVE ABILITY

You might suspect that individuals who differ in terms of cognitive skills would also differ in terms of verbal learning. Although there is evidence to support this idea, the relationship is not a strong one. In several studies using intelligence test performance (see Chapter 15) as a measure of cognitive ability, it was found that for average children, i.e., children who are neither extremely bright nor extremely dull, there is only a moderate relationship with verbal learning ability. On the other hand, there are more pronounced differences between very bright and very dull children (Stevenson, 1972).

ANXIETY

Anxiety will be discussed more thoroughly in Chapter 14. For our purposes now we shall consider it as an unpleasant state characterized by rather nonspecific fears and various autonomic symptoms. Furthermore, some people seem to be chronically anxious, while others are not. A number of studies have shown that people who are highly anxious do more poorly at verbal learning tasks than less anxious individuals. The effects of anxiety can also be seen in school work: more anxious students have poorer grades, even though they may be sufficiently intelligent to perform well. For some reason, boys seem to be more disrupted by anxiety than girls, and individuals who are less intelligent are also more adversely affected by anxiety. Also, the more difficult the learning task, the more likely it is to be disrupted by anxiety.

An interesting example of the relationship between anxiety, intelligence, and performance is seen in a study by Spielberger (1962). He collected three measures on each of a number of college students: a measure of scholastic aptitude, a measure of chronic anxiety, and grade point average. The relationship between these variables is shown in Figure 8.4. As you can see, brighter students (as inferred from higher scholastic aptitude scores) were less adversely affected by anxiety than the less bright ones, and the

greatest difference in performance related to anxiety was for students of intermediate scholastic aptitude.

PAST EXPERIENCE

No two individuals have the same background in terms of past learning, and thus we would expect that no two individuals would be exactly the same with respect to verbal learning. To take an obvious example, if one of your parents speaks French fluently and uses it reasonably often at home, then you should be able to learn French more easily than someone who has never heard it before. Almost all of your so-called new learning actually builds upon past learning. Psychologists call this effect of old learning on new learning the *transfer of training*, or, simply, *transfer*. This topic is so important that it deserves a section all by itself.

Transfer of Training

When something that was learned previously influences the ease of learning something new, then transfer of training has occurred. Sometimes the transfer is *positive*, in that new learning is helped by the old learning, and sometimes it is negative—what you learned previously makes it more difficult to learn something new. Take, for example, learning a new language. Some words of the new language may be cognates of the English word, in that they are spelled similarly and have the same meaning. For example, the French word corresponding to the English verb *charge* is *charger*. Other words may be easily translatable because of their relationship to English words that are associated with the word in question. The French *livre* means *book*, and is related to the English word *library*. On the other hand, there may be false cognates, French words that sound like a particular

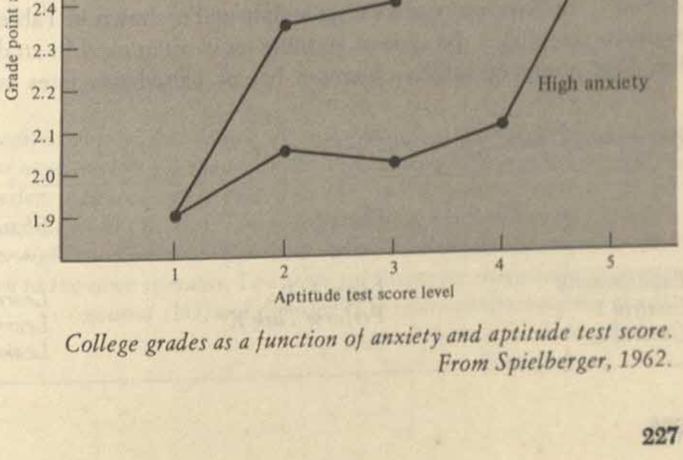


FIGURE 8.4 *College grades as a function of anxiety and aptitude test score. From Spielberger, 1962.*

English word and have none of its meaning. *Pain,* for example, means *bread* to a Frenchman and an *unpleasant sensation* to an Englishman. If English is your native tongue and you are trying to learn French, you will get positive transfer from true cognates, and negative transfer from false cognates. Another type of example: the word *cheveux* means *hair, chevaux* means *horses.* They are easily confused, and learning the meaning of one of them will provide negative transfer for the learning of the other. Imagine telling someone that you would like to run your fingers through his or her beautiful horses!

The existence of educational institutions is a reflection of the implicit assumption that much of previous learning transfers positively to new learning. It is assumed, for example, that what you are learning now will somehow transfer in a significant and positive way to real life. Unfortunately, you will probably not find two educators who will agree as to exactly *how* your present learning will transfer. There is a long history to this question. For a long time educators in the classical tradition assumed that learning Greek, Latin, ancient history, etc., would exercise one's faculties and thereby sharpen his intellect to prepare him better for life ahead. This notion was sharply criticized by some early psychologists, including William James, who rejected the notion that one's intellect was composed of faculties. James did the first experiment in transfer and showed that previous learning influenced new learning only when elements that were present in the previous situation were present in the new one. While the matter is not so simple, as we shall see shortly, James's work did call into question the prevailing attitudes. You are probably aware that much of the present turmoil in higher education pertains to these same issues—whether or not what is learned has anything at all to do with what one is going to do when he gets out into the real world.

How do we know when transfer is going to be positive and when it will be negative, and exactly what is it that is "transferred" to the new learning situation? Since William James's time there has been a large number of experiments which have attempted to answer these questions.

MEASURING TRANSFER

First, it is necessary to have some way to measure transfer. In other words, we must know when transfer has occurred and how much has occurred. Actually, the basic process is rather simple and is shown in Table 8.2. Paired-associate learning is the type of learning most often used in studies of transfer. One group of subjects learns a list of paired-associates consisting, of

TABLE 8.2 *Experimental paradigm for studying transfer*

	Phase 1	*Phase 2*
Experimental	*Learn* A–B	*Learn* C–D
Control 1	*Perform Task* X	*Learn* C–D
Control 2	*Rest*	*Learn* C–D

course, of a set of stimulus items (designated in the table as *A*), each of which is paired with a response item (designated as *B*). A second, control, group does not do anything or else performs some other task. There may be two control groups, as shown in the table. Then all groups of subjects learn another list of paired-associates, again consisting of a set of stimulus terms (this time designated as *C*), each of which has a response term (*D*). The amount of transfer is indicated by comparing the experimental group with the control group. If the experimental group takes less time or makes fewer errors in learning list *C–D* than the control group, then we can say that positive transfer occurred. If the reverse happens—the experimental group makes more errors or takes more time—then negative transfer is indicated.

You may wonder what we would say if the two control groups, one of which rested and the other of which performed some other task, turned out to have different scores on the *C–D* list. This analysis leads to the question of *what* is transferred, which we shall consider presently. First, we must deal with the question of predicting when transfer will be positive and when negative.

WHEN IS TRANSFER POSITIVE AND WHEN NEGATIVE?

Experimenters have manipulated the relationship between the first list and the second list for the experimental group in order to influence the amount and type of transfer. There are various possibilities. In general, the results are summarized in Figure 8.5. This strange graph, which must be read as a

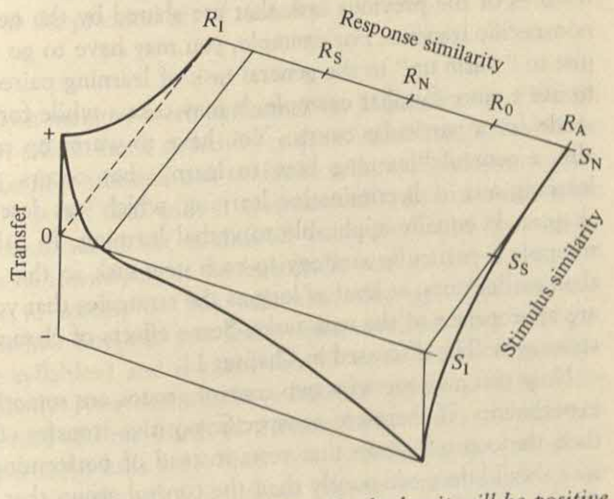


FIGURE 8.5

Osgood's transfer surface. The amount of transfer and whether it will be positive (+) or negative (−) is shown on the vertical axis. The greatest amount of positive transfer, indicated by the peak near the "+" is found when both stimuli and response are identical (R_I, S_I)*. The greatest amount of negative transfer noted at the lower right corner below "*S_I*" occurs when an antagonistic response* (R_A) *must be given to the same stimulus. The other subscripts for stimuli and responses neutral (N), and opposed (O) relationships between the old and the new learning problem.*
From Osgood, 1949.

three-dimensional drawing, is called Osgood's transfer surface. What it shows is the following: When the stimulus terms of the first list are the same as those of the second list and the response terms are different, transfer is negative. If both stimulus and response terms are the same, transfer is positive. As the similiarity between the stimulus terms is reduced, transfer will be reduced, but will continue to be positive as long as the response terms are similar. However, as the response terms become less similar, transfer shifts from positive to negative. If both stimulus and response terms are completely dissimilar in the two lists, i.e., if the problems are completely different, there will be no transfer. Also there is no transfer if the response terms are the same but the stimulus terms are completely different.

While there is some disagreement about certain specific predictions of Osgood's surface, and its predictions are not always borne out, it is accepted as a reasonably good model for the transfer of training. The basic problem is that transfer depends upon many factors in addition to the similarity between stimulus and response terms so that any model which depends only upon these two variables must be of limited scope. In other words the surface deals primarily with the transfer of *elements* learned in one task to another task.

WHAT IS TRANSFERRED?

In the last sentence we have part of the answer to the second question posed above: What is transferred? Part of what is transferred is elements—specific features of the previous task that are shared by the new task. There is also nonspecific transfer. For example, you may have to go through several tasks just to "warm up" to the general task of learning paired-associate lists. (Or, to use a more familiar example, it may take a while for you to learn how to study for a particular course. You have to warm up to the task.) There is also a general "learning how to learn" that occurs. The development of learning sets in discrimination learning, which was described in the previous chapter, is equally applicable to verbal learning. In other words, you learn to apply a particular strategy to each new task so that later tasks are easier than earlier ones, at least as long as the strategies that you learned previously are appropriate to the new tasks. Some effects of changes in the appropriate strategy will be discussed in Chapter 11.

Now you may see why two control groups are sometimes used in transfer experiments. If there are nonspecific positive transfer effects in a given task, then the control group that rests instead of performing the irrelevant first task should do more poorly than the control group that has the first task. If the nonspecific transfer is negative, then the reverse should occur.

COMMENT

It may seem like quite a stretch to move from laboratory studies of transfer to problems of transfer in real life, particularly those which face educators in making decisions on, say, matters such as curriculum and course content. This is true. You need to be aware, however, of the motivation behind the laboratory studies of transfer. Laboratory investigators are concerned with developing as accurate as possible an account of the factors that influence

transfer. To accomplish this task, it is necessary to eliminate from an experiment many of the factors that are present in real life situations, and the results may seem somewhat abstract. Progress is being made, however. At this point we need to know much more about the nonspecific aspects of transfer just mentioned, and, in particular, what might be termed the transfer of strategies.

Memory

One of the most persistently fascinating problems in psychology is that of memory. You may approach the problem philosophically by noting that, for better or for worse, one's future always includes a good bit of one's past, or that one is never independent of his past. Or, you may simply take note of the fact that much of your previous experience is somehow available to you in the present, and wonder how this can be. If you are biologically inclined, you may wonder what happens in the brain to make memory possible. If your inclinations are practical, you may wonder how you can improve your memory.

Our approach will be first of all to describe some aspects of the experimental study of memory, including how memory is measured, different types of memory, different approaches to the question of what a memory consists of, and different answers to the question of why we forget. Then we will consider mnemonics, or the practical art of memory.

Measures of Retention

SAVINGS

The first experiments on memory were performed by Hermann von Ebbinghaus and published in a little book called *Uber das Gedachtnis* (*Concerning Memory*) in 1885. His first problem was to devise some method for measuring memory so that he could deal with it systematically, and in many ways this was his major contribution. It is difficult to study any phenomenon without some means of identifying it systematically and measuring it, and Ebbinghaus was able to accomplish this task with memory. His reasoning went something like this: Suppose you learn some material (say, a poem, or a list of nonsense syllables) and it takes you 10 times through it before you can recite it perfectly. Now that you have learned it, you go about your business for some period of time (such as 24 hours or a week or whatever time interval the experiment calls for). Next you want to see how much of the material you have remembered. Ebbinghaus reasoned that if any of the material were retained, then it should be easier to relearn the list than it was to learn it originally. If original learning took 10 trials and relearning took only 5 trials, then presumably half of the material was retained, or "saved" from the previous learning. The amount of savings would be indicated by the formula

$$S = \frac{O-R}{O} \times 100,$$

where S = savings, O = the number of trials required for original learning, and R = the number of trials required for relearning. The expression is multiplied by 100 to give a percent savings. This is the *savings method.* With nonsense material, most of it is forgotten quite rapidly, but some small amount is retained for a rather long period of time. With meaningful material more material is retained over the longer intervals. (See Figure 8.6.)

RECALL

Other measures of memory require some way of identifying the *amount* of material that is learned. There is no problem in the case of lists of words or nonsense syllables—you simply count the number of items. However, for coherent material, such as a poem or a passage of prose, it is the units of meaning that are important, and the experimenter must make some arbitrary decisions as to what the units of meaning are. Try this for Lincoln's Gettysburg address and you will see the problem. Given, however, that some identification of the units is possible, then retention may also be measured by the *recall* method.

The subject's task is simply to report, either orally or in writing, whatever he was supposed to remember. His score is the number of items correctly recalled. This is the most direct measure of retention, and it is also the one that is the most difficult from the subject's point of view.

RECOGNITION

In recognition, all that is required is that the items in the list be recognized after the retention interval. One way to make this measure work is to con-

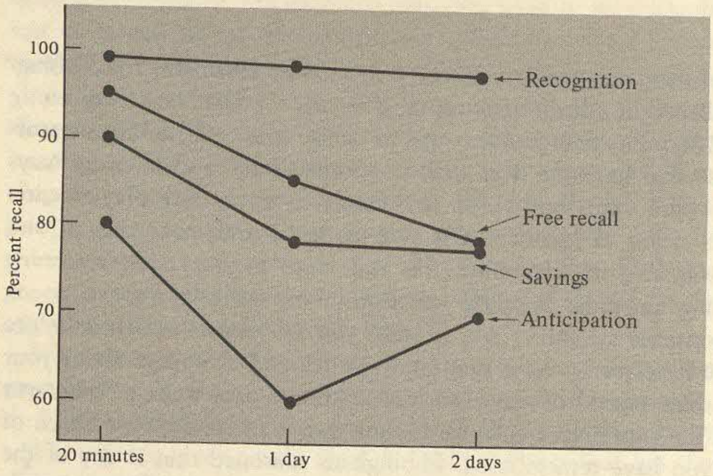


FIGURE 8.6 *Retention of a serial list of words measured in four different ways. Subjects learned a serial list of words until they could give one correct recitation in which, as each word was presented, the next one in the list could be given correctly. Recognition memory was tested with a multiple-choice test. In free recall, the subjects wrote down as many words as they could, without regard to order. In savings, they relearned the list as described in the text. In anticipation, the number of correct anticipations on the first trial of the savings method was used. From Postman & Rau, 1957.*

struct a test list containing some old items and some new ones. The subject's task is then simply to say "old" or "new" in response to the items as they are presented. His score could be simply the number of old items correctly recognized as such. There are also more sophisticated ways to determine how well the subject discriminates old from new items, but we will not go into them here. You are probably most familiar with the multiple-choice test, which uses the recognition measure of retention. Your job is to select the correct answer from a list of four or five alternatives.

When the three methods are compared, the recognition method usually produces a higher score than recall or savings (Figure 8.6). The reason seems to be that different processes are involved. Any method which requires that the subject generate a correct response, i.e., learn to say a particular word in the right place, is going to be more difficult than simply noting that a present stimulus is the same one that was experienced previously. You have probably experienced one instance of this difference in the so-called tip-of-the-tongue phenomenon. You see someone on the street, recognize his face, and want to call him by name. However, you cannot produce the name. You know you know it but cannot say it. By the same token, multiple-choice tests are probably a more sensitive measure of your retention of course material than recall tests (i.e., essay or short-answer questions).

Types of Memory

So far we have discussed memory as though it were a unitary phenomenon. While the issue is a controversial one among students of memory, there is a good bit of evidence to suggest that there are perhaps three different types of memory which in many respects function in different ways. They have been termed *sensory memory, short-term memory* (STM), and *long-term memory* (LTM). (See pp. 36–38.)

SENSORY MEMORY

Sensory memory is quite transient, lasting only on the order of 1 or 2 seconds. When a sensory system is stimulated, the impression lasts longer than the stimulus. If, for example, you look at a visual display of letters that is exposed for a very brief period of time, say, 0.1 second, the information is stored as an image of the stimulus. This image is sometimes called an *icon* (Neisser, 1967), which is from the Greek word for *image* and it lasts for a brief period of time after the display has been turned off. During that period of time, which may be as short as a few tenths of a second or as long as 4 or 5 seconds, depending upon the conditions of stimulation, one can still "read" the information contained in the icon (Sperling, 1960). However, once it fades, it is, so to speak, gone forever. A similar phenomenon occurs for hearing, and the auditory icon is sometimes called an *echo* (not to be confused with an echo that results from the reflection of sound waves off a surface; this echo is internal). Since the icon and the echo fade after a brief time, if the information is to be remembered for longer it must be transferred into short-term memory.

SHORT-TERM MEMORY

Short-term memory lasts for about 30 seconds, but material stored in STM can be kept alive for a longer time by means of rehearsal. Rehearsal is an

active process in which one repeats the material silently until it is either used and then forgotten, or transferred to long-term memory. When you look up a number in the telephone directory, you probably rehearse it until you are able to dial the number, at which point it may be forgotten. If the line is busy, you may even have to look up the number again.

How was the duration of STM discovered, since it can be prolonged almost indefinitely by rehearsal? A method for studying STM was developed by Peterson and Peterson (1959). What they did was to prevent the subject from rehearsing by giving him a task that made rehearsal impossible. They would show the subject a nonsense syllable, which he knew he was to recall later as soon as a signal was presented. However, during the retention interval the subject was required to count out loud, starting with some number and going backward by threes or fours. This task made it impossible for him to rehearse the nonsense syllable. They presented the signal to recall at various periods of time after it was originally presented. Their results are shown in Figure 8.7. You can see that very few of the syllables were successfully recalled after 20 seconds.

Another characteristic of short-term memory is its *limited capacity*. Only about five to seven items can be retained at any one time in STM. One way to measure this capacity is by the digit-span test. The subject is given a string of numbers to recall in order, and the number of digits presented is increased until he makes a mistake. Unless some means of coding the numbers is possible, most subjects begin to make mistakes after about seven digits.

The digit span can be increased considerably by rhythmic grouping or by *coding*. A 10-digit telephone number (i.e., an area code plus the 7 digits of

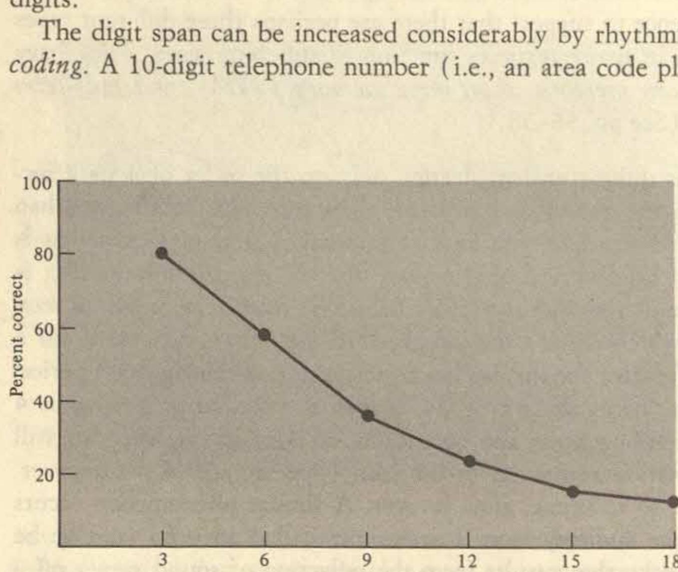


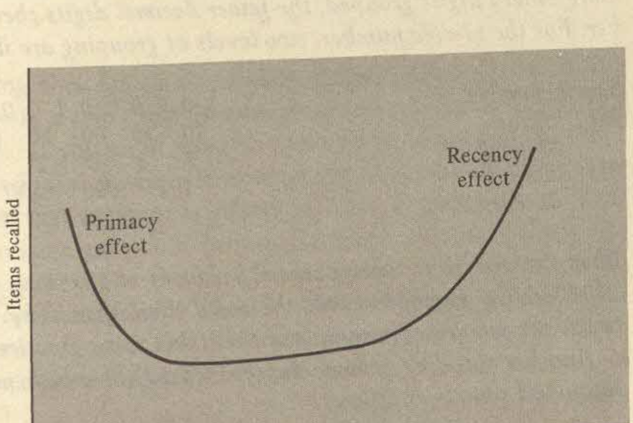
FIGURE 8.7 *The forgetting of a single nonsense syllable. The subject was shown a syllable and then performed a distracting task for 3, 6, 9, 12, 15, or 18 seconds, after which he attempted to recall the syllable. The curve shows that retention falls off quite rapidly when rehearsal is prevented by the distracting task.*
From Peterson & Peterson, 1959.

the local number) can be remembered quite easily because the number is broken up into groups of 3, 3, and 4 digits. You may even remember three or four more numbers specifying an extension in this way. Without the grouping, however, most people would have difficulty with more than seven digits.

Coding is a form of grouping in which you establish (in LTM) a system whereby several digits or other items are represented by one item in the code. Instead of carrying around all of the items in STM, you simply remember the code names. Since each code name specifies several items, recalling a code name results in recall of the items going with it. Coding is one of the bases for mnemonics, which is discussed later in this chapter. Another instance of coding and its results are shown on pages 236–237.

A phenomenon related to the limited capacity of STM is the *serial position curve,* which is usually found in free recall situations. If a subject is given a list to recall, his performance will take the form shown in Figure 8.8. Items at the beginning and the end of the list will be recalled better than those in the middle. Superiority in recall of the last few items is called the *recency effect* and probably occurs because these items are still in STM. The middle items, on the other hand, have probably been "bumped" from STM by the more recent ones. Better recall of the first items, the *primacy effect*, may be due to the fact that they are rehearsed more during presentation than the middle items and are in some form of long-term memory.

According to some theorists another function of STM is that whenever you recall something from LTM, it must be transferred back into STM before an overt response can be made. Thus, when you try to remember the capitals of the states, which are presumably stored in LTM, each item must go through STM before you can say it. You would expect that since STM has a limited capacity, you would be unable to rehearse new material at the same time that you are trying to recall material from LTM. This seems to be the case, as the Peterson and Peterson experiment mentioned above demonstrates.



The serial position curve. FIGURE 8.8

Coding to Improve Memory

One of the secrets of memory experts is to use prelearned codes for remembering material that, otherwise, would be quite difficult to remember. George Miller (1956) reports one person who taught himself to remember long strings of 1s and 0s (such numbers are called binary, *since there are only two values) by recoding them into decimal form, according to the following method.*

Assume that the binary number 101000100111001110 is to be recalled. The digits may be recoded into decimal form in several ways. Basic to all of them is the following conversion table.

Binary	*Decimal*
000	*0*
001	*1*
010	*2*
011	*3*
100	*4*
101	*5*
110	*6*
111	*7*
1000	*8*

In other words, instead of counting to 10, you count to 1 and then shift places. The decimal number 25 would be coded in binary form as 11001. (You figure it out.)

The number to be recalled may be recoded in various ways, depending upon how many binary digits are to be grouped together. Obviously, the more binary digits grouped, the fewer decimal digits there will be to remember. For the sample number, two levels of grouping are illustrated as follows.

Sample number		*1 0 1 0 0 0 1 0 0 1 1 1 0 0 1 1 1 0*								
2:1	*Groups*	*10*	*10*	*00*	*10*	*01*	*11*	*00*	*11*	*10*
	Recoded	*2*	*2*	*0*	*2*	*0*	*3*	*0*	*3*	*2*
3:1	*Groups*	*101*	*000*	*100*	*111*	*001*	*110*			
	Recoded	*5*	*0*	*4*	*7*	*1*	*6*			

Thus, in the 3:1 scheme the 18 binary digits may be remembered as "504716," a number within the usual digit span. The problem is to learn to use the scheme efficiently, and that takes some practice.

Another recoding scheme has been used, in which numbers are recoded into word sounds as follows:

Number	*Sound*
0	*"ess," "ZZZ"*
1	*t*
2	*en*
3	*em*
4	*r*
5	*el*
6	*sh, j, or, g as in George*
7	*k as in* kook, *or g as in* gone
8	*ef*
9	*b or p*

Both of these recoding schemes require a lot of practice in order for them to be used effectively. However, once the scheme is learned, then you may demonstrate some rather remarkable feats of memory.

LONG-TERM MEMORY

Long-term memory is different from STM in several respects. First of all, it has a very *large capacity*. Just think for a moment of all the things that you have stored in LTM. Perhaps the best way to do this task would be to take a day off and simply try to recall as many events from your past as possible. It would probably take you much more than a day to perform this task and you could probably spend your time to better advantage. The point is, however, that LTM has an almost infinite capacity.

Another feature of LTM is that it is essentially permanent. This point has been debated throughout the years, but one increasingly respectable view is that once material is transferred to LTM, it stays there. More will be said about this point later, when we consider the problem of forgetting.

What Is a Memory?

We have been talking thus far (and, incidentally, will continue to do so) as though a memory is a *thing* that is somehow *stored* in some *place*, presumably in the brain. If you recall what you learned in Chapter 2, you will recognize this discussion as a supreme example of *reification.* It is well to make the point now that memory is, above all else, a *construct* which is invoked to explain certain aspects of behavior, namely, that individuals can recall events which occurred in the past, either by behaving appropriately or by making appropriate verbal responses. Now, different psychologists have different understandings of the construct memory, and some of these views will be discussed in the following sections.

TRACES

One very old notion is that a memory is a *trace* left by the stimulus, like a footprint in the sand or a well-beaten path. Presumably, the trace is like a faint copy of the original activity in the brain produced by the event that

is remembered. Retaining a memory requires, according to this view, occasional reactivation of the trace or else it will fade. Since many memories persist for long periods of time without reactivation, this view is not very attractive at the moment. However, if we simply translate "trace" as some physiological change in the brain that is produced by the experience, then the concept may still be useful. It remains, however, to determine exactly what these hypothetical changes are.

ATTRIBUTES

Benton J. Underwood (1969), one of the most active modern researchers in memory, has suggested that memory can best be understood as a collection of *attributes*. An attribute is a feature of an object by which you can describe it. A table, for example, has certain attributes by which you can describe it and differentiate it from other objects. By the same token an experience may have certain attributes that enable you to differentiate it from other experiences. Underwood suggests that the attributes of a memory include (1) the *time* at which the remembered event occurred relative to other events, (2) *where* it occurred relative to other events, (3) *how often* it occurred, (4) whether it was seen or heard or felt, in other words, the *modality* with which the event was experienced, (5) *orthographic attributes* such as, for words that are read, the shape of the letters, and (6) *associative attributes* that include the attributes of other events which are related in some way to the experienced event. Thus, when you remember a certain experience with a table, you store a collection of attributes including when, where, and how often; the perceptual characteristics; and related objects such as a chair and a lamp. Establishing a memory, then, involves the storage of these attributes and some indication as to how to retrieve them later. Often, as in the tip-of-the-tongue phenomenon, you may be able to recall certain attributes of the experience but not the whole thing. For example, in trying to answer a question on an examination you may recall where the answer is on the page in the textbook but not the answer itself. Or you may be able partially to describe someone whose name you are trying to remember but not be able to remember his name. In other words, certain features, but not enough of them, are retrieved.

RECONSTRUCTION

Another view is that memory is essentially a synthetic process, whereby you *reconstruct* a past experience (Bartlett, 1932). From this point of view what is stored is a *set of rules* whereby you can reconstruct the experience. In other words, it is not experiences themselves that are stored, but the means for producing them.

Regardless of whether a memory is conceived of as the traces left by an experience, a collection of attributes, or a set of rules, we are left with the necessity of eventually talking about traces in some form or another. An "attribute" or a "rule" must be represented by some kind of activity in the nervous system. Until such a substrate for memory can be identified, we must still regard memory as primarily a construct invented to explain the persistence of learned behavior.

Forgetting

Perhaps you are somewhat confused by now. You were told earlier that long-term memory is essentially permanent, but, at the same time, you are faced with the obvious fact that people forget. How can forgetting be explained in the context of a permanent memory?

First of all, the acceptability of the notion that memory is permanent is fairly recent. Earlier psychologists thought that forgetting occurred because the traces of past experiences faded with time, unless they were reactivated by practice. Supposedly a trace, once faded, was gone forever. However, the psychoanalyst Sigmund Freud argued that many experiences were actively *repressed* because of their anxiety-producing nature, and that they could be revived through the procedures of psychoanalysis. Furthermore, the work of Penfield (Penfield & Roberts, 1959) discussed in Chapter 4 indicated that stimulation of areas within the temporal lobe could cause patients to report past experiences of a rather trivial nature that had been forgotten for a long time.

So, given the possibility that LTM is permanent, we must somehow explain why responses that were learned at one time are no longer made, and why earlier experiences can often not be recalled. Three possible explanations will be discussed below: *interference, distortion*, and *retrieval failure*. Repression, another possible explanation, will be discussed in Chapter 17.

INTERFERENCE

An experiment by Jenkins and Dallenbach (1924) showed that it is not time per se that is responsible for forgetting but what happens in time. They had subjects learn material and then attempt to recall it after various retention intervals during which they either slept (in the laboratory) or went about their daily business. Their results are shown in Figure 8.9. As you can see, retention after sleep is somewhat better than retention after an equivalent period of waking activity. This experiment led to the view that

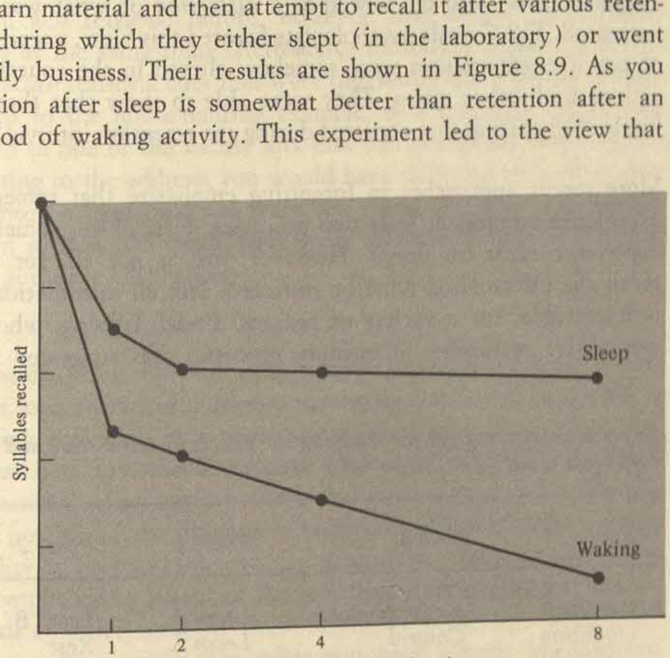


FIGURE 8.9

Retention after varying periods of time of sleep or waking activity.
From Jenkins & Dallenbach, 1924.

forgetting is a result of *interference*. More specifically, it was suggested that forgetting occurs because other things that are also learned interfere with recall.

There are two ways in which interference may occur. New learning that occurs during the retention interval may interfere with the recall of the old learning, in which case the phenomenon is called *retroactive inhibition*. (The prefix "retro" means "backward," and it may help to think of the new learning as "acting backward" to reduce what was remembered from the old learning). On the other hand, learning that occurred *before* the learning in question may also interfere with recall. This kind of interference is called *proactive inhibition* (remember that "pro" means "forward" and the interfering effects "act forward" to reduce recall of the material in question). The results of the Jenkins and Dallenbach experiment were presumably caused by retroactive inhibition.

Retroactive and proactive inhibition are similar in many respects to negative transfer, discussed in a previous section. The difference is that these concepts refer to what happens in *recall of what was learned*, whereas transfer refers to the effect of past learning on the ease with which new material is *learned*. Inhibition and transfer may be demonstrated experimentally, however, in much the same way. The experimental paradigms for interference are shown in Table 8.3. Compare this table with Table 8.2, and you will see the similarity.

DISTORTION

Forgetting may also be viewed as a *distortion* of what was previously experienced. The Gestalt psychologists favored this view, suggesting that traces of previous experiences were somehow altered in the course of their interactions with other traces. They were able to show that there were regular kinds of distortion that occurred during the retention interval.

RETRIEVAL FAILURE

More recent approaches to forgetting emphasize that remembering a past experience requires at least two processes. First of all, something about the experience must be *stored*. However, that is not all, for at the time of recall the information must be *retrieved*. Not all information that is stored is retrievable, for a variety of reasons. Endel Tulving, who is currently a very active researcher in memory processes, has suggested that the means

TABLE 8.3 *Experimental paradigm for studying the effects of retroactive and proactive inhibition upon recall*

Test	*Group*	*Phase 1*	*Phase 2*	*Phase 3*
Retroactive inhibition	*Experimental*	*Learn* A	*Learn* B	*Recall* A
	Control	*Learn* A	*Rest*	*Recall* A
Proactive inhibition	*Experimental*	*Learn* A	*Learn* B	*Recall* B
	Control	*Rest*	*Learn* B	*Recall* B

for retrieval of information are usually established when the information is stored; if appropriate retrieval cues are not established at storage, then retrieval will be very difficult (Tulving & Psotka, 1971). The following illustration may help in understanding this point.

Imagine yourself in a town for the second time, looking for an address that you remember from the first time you were there. If you could get to the right street, you would probably recognize the house you were looking for. However, the problem is to get to the right street. Without a map, you have to remember how you got there the first time, and some of the information that would tell you which turn to make may not be there. If you could go to the address from several different directions, or else learn very well how to get there in one way, then there would be no problem. There would also be no problem if you had a map that showed your address in relation to all other locations within the town. Both the map and the well-learned route may be considered as analogous to retrieval cues in memory. If the cues are there, then the memory is accessible. If not, it may as well not be there, since you cannot get to it.

In verbal memory various retrieval cues are available. If you do the experiment described on p. 242, you will see one instance of the usefulness of category names as retrieval cues.

The above approaches to memory are not necessarily incompatible with one another. They mostly stress different aspects of the process. Perhaps one exception is the fading trace notion, which seems rather obsolete. Interference, distortion, and retrieval failure, however, may simply be different ways of looking at the same thing. Retroactive inhibition could, for example, serve to obscure retrieval cues that were previously quite clearly demarcated. To return to the house-hunting example, if a shopping center had been constructed in one of the vacant lots that you previously remembered as a cue for getting to the address, you would have difficulty in finding your way. If it has been a long time you were last there, the trees and bushes may have grown so that you would have some difficulty in recognizing the house once you got there (distortion).

Mnemonics

You have probably heard tales of people with fantastic memories, who could remember long strings of numbers, names, etc., and who may make a good living doing nightclub acts showing off their memories. You have probably also sat next to someone in class who could remember so much of the course material when writing a test that you wondered how he did it. While some portion of the differences between individuals with respect to memory ability is probably biologically determined, there is also a lot that can be accomplished by means of the selection of strategies for remembering. We shall consider some of these strategies presently. What they involve is really nothing more than what you have already encountered earlier in this chapter. Mnemonics, or the art of memory, is basically the efficient application of principles that have already been elaborated, primarily those concerned with imagery and coding.

Demonstrating the Influence of Organization on Memory

It has been pointed out in this chapter that the better the material is organized, the better it will be recalled. The experiment to be described is one that you can do very easily with several of your friends as subjects. It is based upon the fact that much of what we learn can be hierarchically organized. The category "reading material," for example, contains such items as "books," "magazines," and "newspapers," while the category "occupations" contains such instances as "plumber," "architect," "doctor," etc. If you can recall a category name, the chances are pretty good that you can also recall many of the items within that category. The experiment demonstrates that fact.

The table includes a set of 18 category names, together with one specimen of each category (Battig & Montague, 1969). As experimenter, you read the category name, followed by the specimen, then another category name, then its specimen, etc. Read them aloud slowly, pausing about one second between the category name and its specimen, and about 4 or 5 seconds between the specimen and the next category name.

Category	*Specimen*
An article of furniture	*Chair*
A building for religious services	*Cathedral*
An alcoholic beverage	*Vodka*
A weather phenomenon	*Tornado*
An article of clothing	*Shirt*
A bird	*Robin*
A type of vehicle	*Car*
A vegetable	*Carrot*
An insect	*Mosquito*
A tree	*Maple*
A college or university	*Harvard*
A state	*New York*
A sport	*Football*
A natural earth formation	*Mountain*
A type of fuel	*Coal*
A member of the clergy	*Rabbi*
An elective office	*President*
A part of the human body	*Arm*

After reading the list aloud as indicated above, ask your subject to recall as many specimens as he can (e.g., chair, etc.), in any order. Thus the free recall procedure is used. Your subject should write down all of the specimens he can remember. Give him as much time as he needs, but he should

have pretty well exhausted his memory in about 3 minutes. As soon as he finishes, have him draw a line under the last word he recalled.

Next, read aloud each category name and ask him to recall any specimens that he did not recall the first time, writing these words down below the line. Go slowly so that he has plenty of time to recall and write.

Your subject, unless he was employing some mnemonic device, should have recalled about 12 or so words the first time. However, the second time, when given the category names, he should have recalled almost all of the rest of the items.

The point is this: You can think of memory as a series of addresses, with each address containing some specific contents. What often happens in forgetting is that the address is lost, and so the contents are not retrievable until the address becomes available. In the first recall attempt the items that your subject was able successfully to recall were those that had been retained in short-term memory which, as you have learned, has a limited capacity, plus those for which the addresses (i.e., the category names) were available in short-term memory. In the second attempt, however, the subject did not have to remember the addresses, or category names, since you gave them to him. All he had to do was to use the category name as an address, the contents of which were relatively easy to retrieve.

From this demonstration you can see that many specific items may be stored in relation to a superordinate address or category name, and that recall of the category name may permit you then to recall the contents of that category or address. Contrast this system with one in which each item must be recalled independently, and it should be easy to see that there is really no comparison.

Other research has shown that when many items come to be organized under a few category headings, even when the category names are not given, recall is better than when organization does not take place.

THE METHOD OF LOCATIONS

The story goes that the Greek poet Simonides was invited to a banquet to read a poem. During the course of the evening he was called out of the banquet hall by a messenger. Just after he left the hall, the walls collapsed, killing all the people. Their bodies could not be identified, but Simonides was able to identify them on the basis of where they were sitting in the hall. He remembered each person as being in a certain location.

The method of locations has been used for centuries by orators who, according to the practices of their time, had to memorize speeches rather than refer to notes periodically. Nowadays written cards, teleprompters, etc., have made it less important to learn how to memorize. Before these devices, however, speakers would become quite familiar with the architectural features of the room in which the speech was to be made. Then they would associate each of the major points in their speeches with some feature of the room, preferably in some regular order. While delivering the

speech they would look at the various features and remember the points associated with each.

This method works quite well. What you have to do is establish firmly in mind some sequence of locations. For example, you might take a walk around the campus and note each major feature in order. Most people have little difficulty with this part of the procedure, since the features are usually quite familiar and remembering them usually involves imagery, which seems to facilitate memory. In order to try it out, have a friend make up a list of 40 or so words. Then have him read them to you slowly, waiting about 8 to 10 seconds between words. For each word, your task is to imagine it in some relationship to one of the features or locations that you have previously memorized. If you remember the features in order, then the first word will be related to the first feature, the second to the second, etc. If you run out of features before the list is finished, then start over again with the first feature. When you have heard the list, try to recall as many of the words as possible by first remembering the first feature and the word associated with it, the second feature next, etc. You should be able to remember most of the 40 words in correct order. One psychologist reported privately to the author that one of his subjects was able to remember 1000 different items in their correct order, having heard them only once, by using this method.

THE ONE-BUN TECHNIQUE

Memorize the following rhyme, which should not be too difficult.

One is a bun.

Two is a shoe.

Three is a tree.

Four is a door.

Five is a hive.

Six is sticks.

Seven is heaven.

Eight is a gate.

Nine is wine.

Ten is a hen.

Next, have someone make up a list, just as before, which he will read to you in order. With each word, try to develop an image in which it is related to one of the objects in the rhyme. For example, if the first word is *freedom,* you might imagine a bun with wings flying away. When you recall the list, recall the objects in the rhyme first, and then try to remember the thing imaged with it. This method also works quite well.

There are various schemes for coding material that is difficult to remember into some form that is easy to remember. As an example of the possibilities, coding a set of binary numbers (0's and 1's) into their decimal equivalents was described on p. 236. Another form of coding that is sometimes practiced by memory experts involves coding numbers into sounds of words; the rules for this coding appear on p. 237. The number 695-8701 would be coded "s h b l f g a t," which could perhaps be remembered as "she blew figs at." Obviously, memorizing the coding system and learning how to use it quickly is itself somewhat of a problem, but once accomplished, the method apparently works quite well. CODING

All of the above methods imply that you must first of all have learned some system whereby new material can be organized. The old organization provides something with which the new material can be associated, made meaningful, and remembered. The techniques are different from the way that you ordinarily go about remembering anything only in that the relationships between the items to be learned and the framework provided by the mnemonic system are especially distinctive and perhaps unusual (e.g., a bun flying away). Also, the framework, once learned, is easy to remember because it involves both imagery and verbal processes. When you think of a bun or the chemistry building on the quadrangle, there is not only (at least for most people) a "picture in the mind" of the object but also its name. Gordon Bower, another psychologist quite active in the study of memory, has suggested that it is this dual representation of concrete objects (dual in the sense that both names and images are available) that makes them recalled better than abstract terms, which, unless special steps are taken such as associating "freedom" with a "flying bun," have only a verbal representation (1970). In other words, if a given experience is represented in two ways it is more likely that it will be recalled than if it is represented in only one way. ORGANIZATION

Summary

Much of the learning done by adults is verbal learning, of which there are three major types: serial learning, in which material must be recalled in the order originally given; paired-associate, in whch pairs of items that go together must be learned; and free recall, in which events must be recalled but not necessarily in any particular order.

A number of factors affect the ease of learning. The nature of the material is important, including its meaningfulness, the tendency to evoke imagery, and the category relationships within it. The conditions of learning are also important, such as the particular context in which learning occurs and the manner of distribution of periods of work and rest. Also important is the learner's strategy: whether he attempts to learn all of the material at

once or in parts, and whether he attempts to organize the material into conceptually meaningful categories. Individual differences in age, intelligence, and anxiety, are also of some importance.

Most verbal learning is not new but is the result of transfer of training from previous learning. Transfer may be positive or negative, in that old learning may facilitate or hinder new learning. Specific elements may transfer from previous tasks, as may more general factors, such as strategies of learning.

Retention may be measured in several ways. The savings, or relearning method, recognition memory, and recall have all been employed. Recall is most difficult, recognition the easiest.

There seem to be three classes of memory: sensory memory, which lasts only a few seconds; short-term memory, which fades after about 30 seconds if rehearsal does not occur; and long-term memory, which is essentially permanent. Psychologists conceptualize memory in various ways: as a set of traces, as a collection of attributes of experiences, and as a set of rules whereby experiences may be reconstructed.

Forgetting has been explained by three different theories: (1) The interference theory assumes that forgetting is due to proactive inhibition, whereby previously learned material interferes with the recall of newly learned material; or retroactive inhibition, in which new material interferes with the recall of previously learned material. (2) The distortion view is that memory traces are distorted through the action of other traces, thus producing errors in recall. (3) The retrieval failure view assumes that the traces are present but unavailable because one has not established reliable "retrieval cues."

Mnemonics, or the practical art of improving one's memory, stresses the utilization of imagery, coding, and other forms of organization. Imagery techniques include the method of locations and the one-bun technique. Other methods employing verbal or abstract coding are also available.

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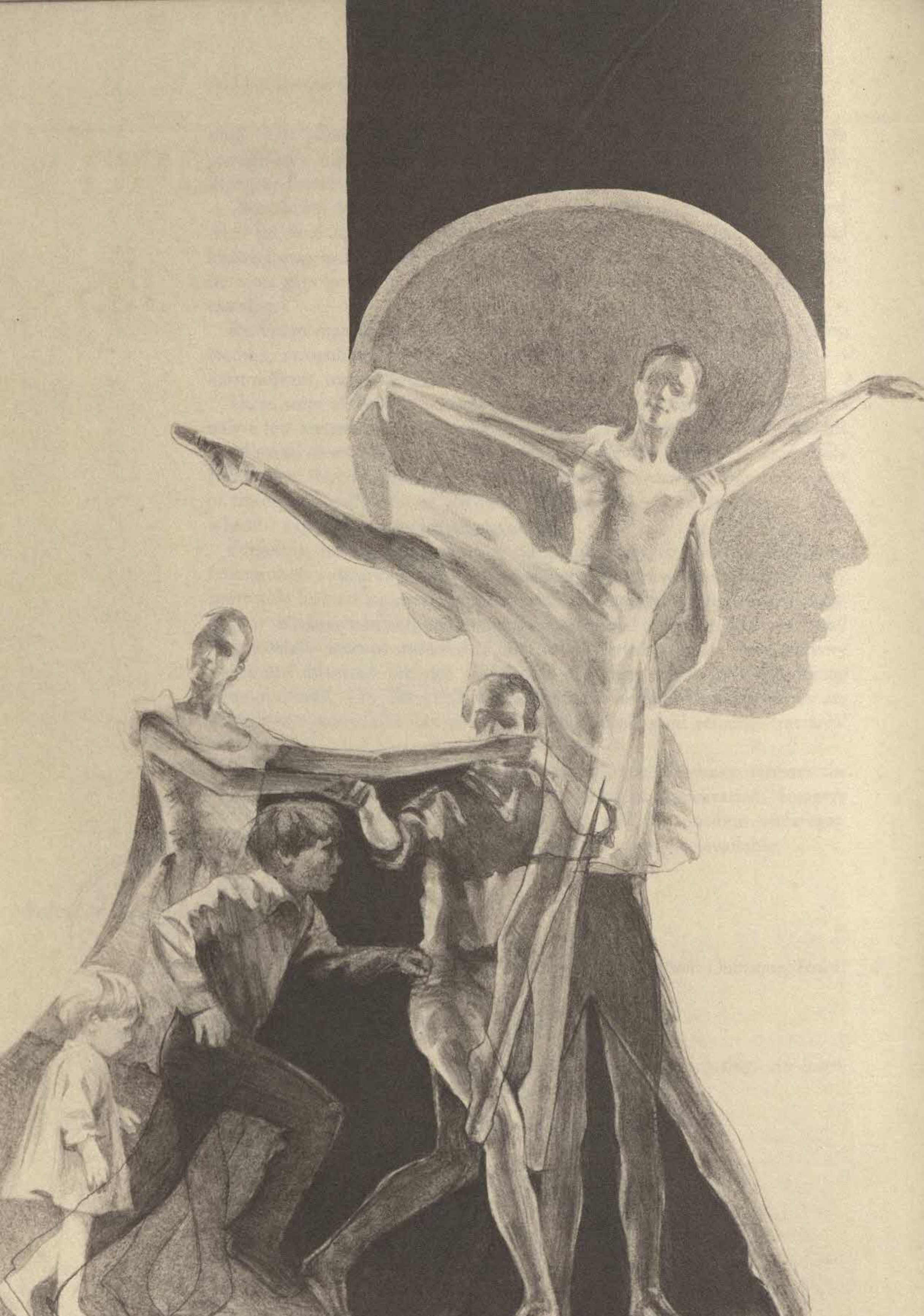


Human Learning and Memory: Motor Skills

9

In the last chapter the focus was on the learning and retention of verbal material, which is more or less of a conceptual nature, with the learning and retention being defined more or less independently of any particular response. For example, a word is a word, whether written or said, and either response would be sufficient evidence of learning in some situations. In this chapter the focus is more on the overt behavior itself. Specifically, we shall consider the learning of those behaviors that are of a highly skilled nature, in which highly coordinated responses must be made to changing external conditions.

In a sense the term *motor skills* is not completely appropriate, since, as you will see in this chapter, the skills that we shall be discussing are not just "motor" in nature. They are also perceptual. Skilled actions cannot be made without the intimate involvement of the perceptual systems that serve to guide the behaviors in question. Thus *perceptual motor skills* would probably be a better term.

Consider, for example, what is involved in playing a violin. The left hand holds the neck between the thumb and first finger and the fingers of that hand press the strings onto the fingerboard in order to produce notes of different pitches. The left hand must know "by feel" exactly where it is on the neck, since the fingering for the various notes is different, depending upon whether it is at the end (first position) or further up the neck (second, third, etc., positions). The bow, held in the right hand, must be drawn smoothly across the appropriate string in a direction perpendicular to the string. Which string is played is determined by the angle of the right arm. Then, the movements of the fingers of the left hand and the bowing of the right hand must be coordinated so that the bow attacks the string at just the right time. Finally, the rhythmic demands of the music that is being

played must be met, not in a mechanical way, but in a sensitive way that is guided by the sound that is produced.

If you are more athletically than musically inclined, you may prefer to consider a baseball player at bat. In a split second he must sense how fast the ball is coming and where it will wind up relative to his own position in the batter's box. He must time his swing and adjust its elevation so that the bat meets the ball at just the right point in time. The frequency of strike-outs, pop-ups, and foul balls attests to the difficulty of this task.

Both of the tasks above would be classified as motor skills, but the perceptual information is equally as important as the motion itself, and a deficiency in either perceptual or motor systems would interfere with successful performance. It is not hard to think of other skills that are an important part of our everyday lives, which can be analyzed in the same way. Reading, riding a bicycle, typing, dancing, driving a car, flying an airplane, and performing a surgical operation all involve the performance of coordinated movements guided by perceptual input.

In the remainder of this chapter we shall consider, first of all, various ways in which perceptual motor tasks may be classified. Then we shall examine some of the factors affecting their learning. Finally, we shall discuss the retention of such skills.

Classification of Motor Tasks

Continuity

One of the important ways in which tasks differ is with regard to continuity. Some tasks are *discrete*, in that they involve a succession of movements, each of which is separable from the other. Other tasks are *continuous*, consisting of a succession of smooth movements that merge into one another.

DISCRETE TASKS

An example of a discrete task is starting the car in the morning. You must (1) insert the key, (2) depress the accelerator pedal, (3) turn the key to start the motor, (4) release the accelerator pedal, (5) release the emergency brake, (6) put the car in gear, and (7) depress the accelerator to begin moving. Other steps may be inserted, such as depressing the clutch pedal in a gear-shift car, fastening the seat belt, noting how much gas is in the tank, checking the warning lights to insure that they go off when they are supposed to, and adjusting the seat to a comfortable position. Typing is another example of a discrete task. One of the characteristics of discrete tasks, as you will see in more detail later, is that their learning and forgetting are similar in many ways to the learning and forgetting of verbal skills.

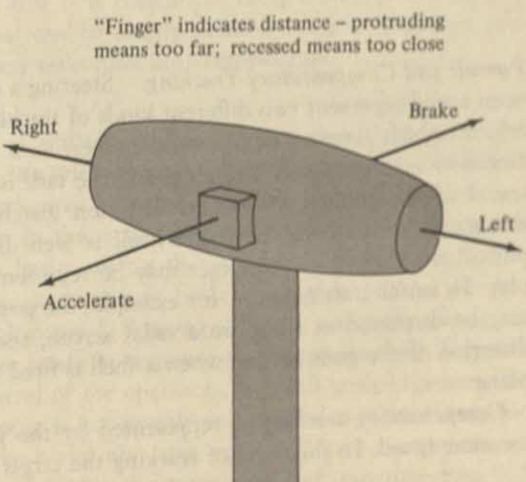
CONTINUOUS TASKS

Other tasks involve the making of more or less continuous movements, the precise direction, extent, and force of which are determined by moment-to-moment variations in the demands of the situation. To continue the example of driving a car, many of the tasks are continuous in nature. In order to keep the car on the road, it is necessary to turn the steering wheel various amounts, and in order to maintain a constant speed, you must depress or release the accelerator as you encounter variations in the road. Continuous tasks such as the two above are called *tracking* tasks.

Perceptual Processes Involved in Automobile Safety

As most people recognize, the automobile is a mixed blessing. On the one hand, it is largely responsible for the extreme mobility characteristic of our culture and, indirectly, for many of the technological achievements that so markedly affect our lives. On the other hand, the automobile is clearly a dangerous weapon, as statistics on highway accidents will easily testify. Safety, then, is economically of great importance as well as of clear personal relevance to those who must drive.

Driving a car in heavy traffic places many demands on the perceptual capacities of the operator, particularly at moderate to high speeds. Consider the problem of maintaining a safe but practical distance between your car and the one in front, for example. What is required is for you to be able to detect when you fall too far behind or come too close. Keeping a constant speed is not very helpful because the car in front is usually not keeping a constant speed. Therefore, you must respond quickly to variations in his speed and reduce or increase your speed appropriately. If you are slow to respond to increases in his speed, then traffic flow slows down. (Just imagine the effect of 100 somewhat slowly reacting motorists in line on an expressway.) On the other hand, if he slows down, and you are slow to react, then a rear-end collision is more likely. The problem, then, is to respond as quickly as possible to changes in the distance between your car and the one in front. Unfortunately, however, the stimuli that specify a change in distance are not very good. If he slows down by putting on his brakes, that is one thing. However, without a brake light, you must visually



note the changing distance by means of the change in the amount of roadway between your hood and his rear bumper and the change in size of the image of his car as projected on your retina.

Robert E. Fenton at the Ohio State University has developed a device that offers a potential solution to this problem. It consists of a control stick that is used to drive the car instead of the usual wheel, accelerator pedal, and brake. Turns are made by pushing the stick to the left or the right, and speed changes by pushing the stick forward (acceleration) or pulling it back (braking). The key to vehicle following, however, is in the head of the stick, which is held by the operator's hand. It consists of a finger that projects out from the head or back into it, depending on whether the operator is too close or too far away from the car behind. The operator's task is to keep the finger flush with the head of the stick, which he can do by following the finger's movement with a stick movement in the same direction.

Experiments have been conducted with this device in actual driving situations and have shown that an operator with just a few hours' practice with the stick control can drive just as well as he can with the traditional controls. Furthermore, when the finger is used to signal the distance between his car and the one in front, he is much better able to maintain a constant distance. In fact, the variability in distance is reduced to about 5 percent of that found without the tactile display.

How might the distance between one car and another be sensed so that the information can be displayed properly to the operator? This, of course, is another problem. In Fenton's studies a Yo-Yo–like cable arrangement connecting the two cars measured the distance. In actual practice some other device would have to be developed, such as a radar or sonar sensor (i.e., which sense either electromagnetic or sound waves reflected from the car in front). Obviously, expense enters into the picture. However, considering present trends in automobile travel, and considering what we know about the limitations of the human being's perceptual system, safe travel will eventually require some such device.

Pursuit and Compensatory Tracking. Steering a car and maintaining a constant speed represent two different kinds of tracking tasks. In *pursuit tracking*, of which steering is an example, there is a *target* (the road), whose direction is continuously changing, and the task is to adjust the direction of travel of the vehicle so that its direction matches that of the target. In driving an automobile, the target itself is seen directly. However, in some pursuit-tracking tasks the target may be represented on some artificial display. In antiaircraft gunnery, for example, the position of the target aircraft may be displayed as a blip on a radar screen, the task being to adjust the direction of the guns so that when a shell is fired it will be likely to hit the plane.

Compensatory tracking is represented by the problem of maintaining a constant speed. In this kind of tracking the target is a fixed reference point

on a display. The display also contains a *controlled element* that represents the vehicle which is being controlled. In the case of maintaining a constant speed, the fixed target is a particular mark on the speedometer. The needle, when it deviates from the target, indicates that there is an error in speed. The job of the operator is to eliminate that error. The instruments in an aircraft that display information such as heading, air speed, and altitude are similar to the speedometer and must be controlled by compensatory tracking. Riding a bicycle is also an example of compensatory tracking. In order to avoid falling down, you must sense information about the deviation of you and your bicycle from the vertical and make appropriate corrections to null the error. In this case the error is displayed internally, rather than externally, but the principle is the same.

Ballistic Movements. Many tasks require the execution of movements whose force, distance, and direction must be adjusted differing amounts, depending on the requirements, but for which there is no continuous control from external sensory information. For example, throwing a baseball from the outfield to home plate requires a rather precise adjustment and control of practically every muscle in the body so that the ball will arrive at the target, at least within tolerable limits of error. However, once the ball leaves the outfielder's hand, no further control is possible.

You can probably think of numerous other examples of ballistic movements from sports. Such skills are continuous in one sense, in that many different gradations of force, direction, and distance may be called for. However, in some sense, they are also discrete, in that they may be identified as single acts. The difference between turning a key, which was given as an example of a discrete task above, and throwing a ball lies in the constraints imposed on the movement. You can only turn a key so far without breaking it or the lock, and, as long as the force is sufficient to overcome the friction and spring tension in the lock, it does not matter how you turn it. It is very hard to do it wrong. Throwing a ball, however, can be done in so many different ways that it is difficult to do it correctly. Continuity, then, is a task variable that can be clearly defined in some instances, and not so clearly in others. Many tasks have both components.

Pacing

Another important aspect of skilled performance is pacing. A task may be self-paced, in that the rapidity with which responses are made is controlled by the operator, or the task may be paced by some external information. Typing is a self-paced task, in that speed is under the control of the typist (within, of course, upper limits set by the nature of the machine). The interval between successive actions may be long or short, since there is usually no external control exerted. Steering a car is externally paced, in that control movements are made in response to changes in road direction that are not under the control of the operator. You will probably recognize specific occasions when typing is not exactly self-paced (as when the typist is typing from a dictaphone) and also that steering has a component of self-pacing in that the faster you go, the more turns per unit time you will

have to make. However, the distinction is still a useful one, and it is possible to design laboratory tasks that are completely self-paced or completely externally paced.

Coherence

Coherence is a term used by psychologists studying motor skills to refer to the repetitive nature of the task. A task is coherent to the extent that its elements are predictable over time. Take, for example, the pursuit rotor, which is a device used in the laboratory to study tracking. One is illustrated in Figure 9.1. It consists of a phonograph turntable with a metal plate on it. The operator's task is to hold a hinged stylus in his hand, and, while the turntable is revolving, attempt to maintain contact with the metal plate. The amount of time he is able to maintain contact is recorded by means of an electric clock that runs as long as electrical contact between the plate and the stylus is maintained. This task is completely coherent, in that the course of travel of the target is completely predictable. The task is also said to be *redundant*, for the same reason. On the other hand, imagine yourself faced with an array of 100 warning lights, each with a switch that must be activated whenever the light is turned on. Furthermore, the lights are turned on randomly. While your task is not completely unpredictable (i.e., you know there are only 100 lights and switches), it is not as

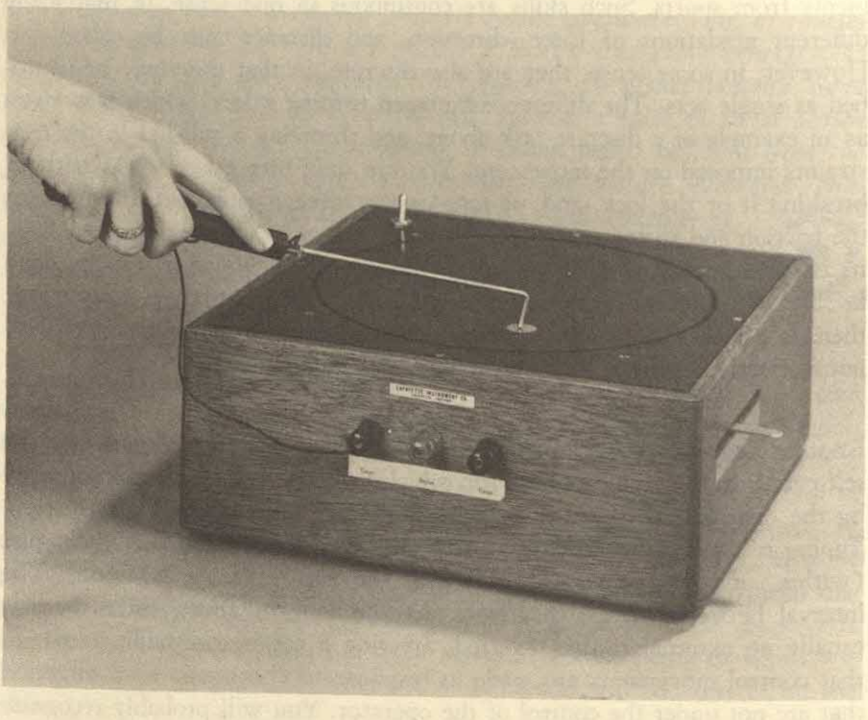


FIGURE 9.1 *A pursuit rotor. The white metal spot rotates, and the subject attempts to keep the stylus on it.*
Courtesy of the Lafayette Instrument Co., Inc.

predictable as it would be if the lights came on in some regular sequence. Driving a car with which you are quite familiar over familiar terrain is a partially coherent task. You know that at a given speed the frequency with which you will have to make corrective movements of the steering wheel and accelerator and brake pedals is limited. You can anticipate, or predict, what you will have to do in the immediate future. Driving over a rocky, narrow mountain trail in an unfamiliar vehicle, however, may be less coherent, in that you can predict less well what you will have to do next.

As you might expect, coherence is a very important variable in determining how easily a task will be learned or how well it will be performed. The greater the coherence, the easier the task.

Complexity

Task complexity refers to the number of responses that have to be made, or the number of elements in a response sequence. It is related to coherence, since many simple tasks are also redundant or coherent. However, not all simple tasks are coherent. The task described above in which the 100 warning lights had to be responded to with a switch activation is simple, in that a given switch action can usually be made in only one of two ways (i.e., on or off), but it is not terribly coherent if the operator has to predict which one of the 100 actions will be called for at any given moment. As you might suspect, complex tasks are more difficult than simple tasks, everything else being equal.

The Acquisition of Skills

Consider the Olympic diver preparing for a meet. The present state of his skill is the result of many years of practice under conditions of high motivation to learn. The chances are that as long as his motivation to improve continues, he will continue to improve slowly over the years (Fitts, 1964). Continuous improvement with practice over a long time is one of the characteristics of the learning of a large number of skills, and one of the goals of studies in skill acquisition is to understand the changes in the nature of the response that take place over such a course of learning. Another aim is to understand some of the factors that affect the course of learning. The two factors that have received the most attention are *information feedback* and *transfer of training* from previously learned skills. These three topics —phases in the learning process, the role of information feedback, and the transfer of training will now be discussed.

Phases of Learning

Imagine yourself faced with a completely new task to be learned. You start out ignorant of why it is to be done, what the general nature of the task is, what materials will be worked with, what kinds of movements will be required, etc. Learning these concepts constitutes the first phase in acquisition of the skill (Fitts, 1964). It is analogous to the response learning phase of verbal learning discussed in Chapter 8. The basic elements of the

task must be sorted out, some familiarity established, and some basic integration of responses made. If the responses are simple and do not complete with each other, then this phase proceeds smoothly. However, some tasks involve the integration of several behaviors that potentially interfere with one another. A novice clarinetist or trumpet player, for example, may have difficulty keeping rhythm by patting his foot and, at the same time, playing the right notes. Watching out for traffic and shifting gears smoothly is a problem for beginning drivers.

Once the basic response repertoire has been developed and some primary response organization has taken place, the next phase involves learning when a particular response is appropriate. In other words, the behavior must become smoothly integrated with changes in the stimulus conditions. This stage sometimes involves verbal mediation. For example, in practicing driving you might say to yourself very quickly: "The light is red, so I have to stop. That means putting on the brake and depressing the clutch before I come to a complete stop." In typing, at the beginning of this stage of practice one is going letter by letter: " 'p' is the little finger of the right hand up, then 'e' is the middle finger of the left hand up, then 'n' is the first finger of the right hand down and to the left, then space bar with the thumb, etc." Later on words and even phrases as a whole are typed as a unit. *Pen*, for example, would be typed as a sequence of three smooth movements without the necessity of going at it letter by letter.

In continuous tasks the second stage involves learning the range of variations in input that one is going to have to respond to and the characteristics of the machine's response to the operator's control behavior. In learning a compensatory tracking task, for example, you must learn (1) how rapidly and how far the controlled element will move away from the target, and (2) what will be the effect of a given movement of the control. Some cars, for example, will deviate quite rapidly from a given speed without your knowing it, while others will not. Some are more responsive than others to corrective movements of the gas pedal. The same kinds of problems are encountered in steering, which is a pursuit task. Some cars wander more than others, and the steering mechanism may be "quick," as in some sports cars, or "slow," as in some rather large limousines.

Later stages of practice are actually continuations of the earlier ones, except that there is a greater and greater focusing on the fine details of performance on the one hand, and the organization of responses into larger and larger units, on the other. Verbal mediation drops out, and behavior becomes more automatic. The result is that speed and accuracy continue to improve. In typing, as in reading, information is extracted from the printed copy in larger and larger units. First letters, then words, then larger and larger phrases are processed as units. It has been suggested (Fitts, 1964) that the only only reason performance *ever* stops improving is that physiological aging and loss of motivation eventually interfere.

Since the acquisition of a skill apparently involves the development of higher and higher levels of organization, it has been suggested that in this kind of learning a "plan," or neurological "program," for making longer

and longer sequences of behavior is involved. Karl Lashley (1951), who was a famous neuropsychologist, made the following observation (Lashley, 1960, p. 516):

> The finger strokes of a musician may reach 16 per second in passages which call for a definite and changing order of successive finger movements. The succession of movements is too quick even for visual reaction time. In rapid sight reading it is impossible to read the individual notes of an arpeggio. The notes must be seen in groups, and it is actually easier to read chords seen simultaneously and to translate them into temporal sequence than to read successive notes in the arpeggio as usually written.

The developmental psychologist Jerome Bruner has suggested that this kind of plan is one of the first to be established. He uses the term *enactive representation* to refer to the internal representation of motor sequences and considers this kind of representation to be primitive, relative to images and verbal representation, which are more characteristic of older children (see Chapter 11). Perhaps that is why behavior such as that described by Lashley seems to be executed in such an automatic fashion. The plan underlying it must be essentially nonverbal in nature.

Lashley goes on to suggest that such behavior must be the result of some neurological program that determines an extended sequence of movements.

Feedback and the Learning of Skills

According to Bilodeau and Bilodeau (1961), "Studies of feedback or knowledge of results . . . show it to be the strongest, most important variable controlling performance and behavior . . . [p. 250]." More recent treatments of the topic have said nothing to indicate that the situation is any different now. As pointed out in Chapter 4, many behaviors can be regarded as a kind of servo loop, in which output, or responses, produce consequences, which are fed back into the system to regulate subsequent outputs.

Consider a driver steering a car. The road curves to the right, so he turns the steering wheel clockwise. Shortly thereafter, the car turns to the right so that the line in the middle of the road is where it ought to be—slightly to his left. The shift in the location of the road relative to the car is one form of feedback. Also, however, the proprioceptors in his arms and shoulders responded to the "feel" of the steering wheel in being turned a certain amount, and he was aware of having to exert a certain effort in making the turn. This proprioceptive feedback occurs in most tasks. In addition, centrifugal force operating during the turn produces a certain amount of sway in the car and forces him slightly to his right in the seat. Finally, a passenger riding in the front seat may have said, "You took that turn too fast."

In general, we may distinguish two broad types of feedback. The first type comes from the response of the system that the operator is controlling, which is called *primary feedback*. The first three examples above are primary feedback, since they are direct sensory consequences of the right turn. The fourth example is so-called *secondary*, or *augmented*, *feedback*, which in the example is a verbal comment added to the primary feedback. Its

information does not come directly from the movement of the system. It would be impossible to drive a car without at least the visual feedback or some equivalent information about where the car is relative to the road; the task is made easier by the additional feedback from the feel of the wheel and the centrifugal forces. Whether secondary feedback is important or not depends on how the task is defined. If the primary task is to please the passenger or if primary feedback is restricted in some way, then secondary feedback is necessary.

Feedback may vary with respect to a number of properties. It may be delayed for various periods of time after the response has been performed. It may occur after every response or only after several responses have occurred, and it may refer to the accuracy of a single response or may reflect the error accumulated over several responses. Its method of administration may range from verbal statements about the adequacy of the response to more direct information displayed on instruments to even more direct information, such as you get when you see the position of the car relative to the road. Finally, it may be distorted in various ways.

EFFECT OF DELAY OF FEEDBACK

Whether or not delay makes a difference depends on the task. Reading out loud, for instance, can be severely disrupted if the ordinary auditory feedback from the sound of one's own voice is delayed slightly. The same is true of delayed visual feedback when the sight of one's hand in performing some task is delayed by the use of a special closed circuit television apparatus. On the other hand, delaying the verbal feedback as to the accuracy of a simple response, such as moving a lever to a certain position, seems to have little effect on learning as long as the feedback is given before the next response has to occur (Bilodeau, 1969).

EFFECT OF FREQUENCY OF FEEDBACK

In general, most learning occurs on trials in which feedback is given, and little if any learning occurs when it is not given (Bilodeau, 1969). Therefore, you would expect that the more frequently feedback is given, the better would be performance, and such is the case. Some kinds of learning situations, you will remember, have feedback built into them, as in steering a car. For such tasks the frequency of extra feedback makes little difference, since enough is present in the task itself. However, when there is little if any intrinsic feedback available, then administering some feedback helps. Figure 9.2 shows the results of one experiment in which the task was one of positioning a lever and the feedback was administered different numbers of time for different groups of subjects.

DISTORTION OF FEEDBACK

While one does not expect engineers to design automobiles or airplanes in which the feedback provided to the operator was distorted spatially, everyone has at some point in his life encountered and adapted to distortions in the sensory consequences of various movements. A child, for example, going through a growth spurt, will perform quite clumsily until he learns that his legs are longer and that a given bit of proprioceptive feedback from running or skipping has to be reinterpreted. In this case the feedback is

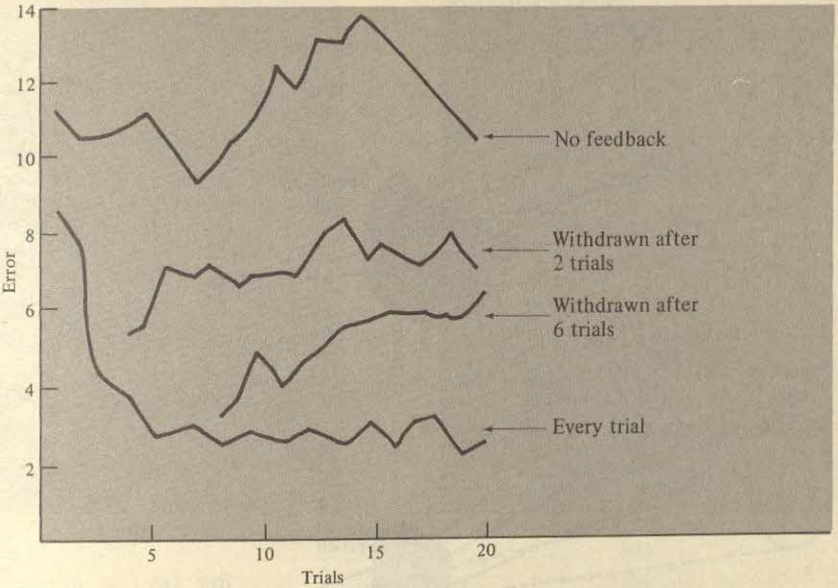


FIGURE 9.2

The effects of information feedback on performance. Note that subjects given feedback on every trial showed a typical learning curve. When the feedback was withdrawn after 2 or 6 trials the performance, which up to that point had been improving, began to deteriorate. With no feedback, performance showed no improvement.

From Bilodeau, Bilodeau, & Schumsky, 1959.

distorted by natural growth processes. A similar distortion occurs in the interpretation of depth information from binocular disparity (Chapter 6) as the head grows wider and the eyes farther apart. Other distortions may be introduced by appliances such as eye glasses which change the normal relationship between eye movements and their visual consequences. (See Figure 9.3.)

In order to understand how sensory feedback from movements operates in skill acquisition, psychologists have experimentally produced distortions in this feedback. One method involves the use of closed circuit television (Smith & Smith, 1962). The operator performs a task with his hands but in such a way that he can only see his hand when it is shown on a television monitor. The TV camera, which is aimed at his hand, may be displaced in space, turned over, etc., so that the image of the hand on the screen is displaced, inverted, reversed, etc., as determined by the experimenter. In general, when visual feedback is displaced in space the process of learning a task is adversely affected (Figure 9.4). Individuals can, however, adapt to the distorting effects of displaced feedback, just as a person who puts on glasses for the first time is soon no longer bothered by the visual distortions.

Transfer of Training in Motor Skills

Perceptual motor skills, like verbal skills, are not acquired in a vacuum. Most of what is learned is influenced to some extent by what was previ-

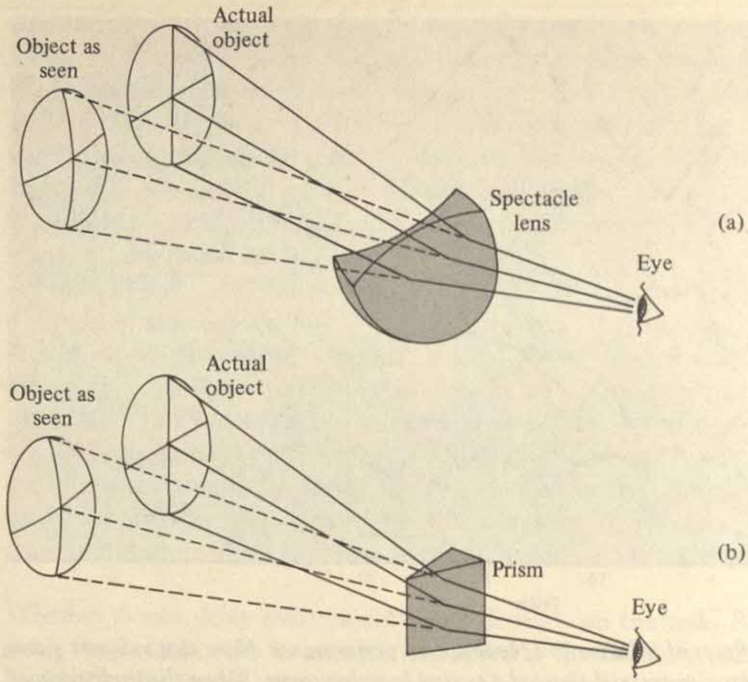
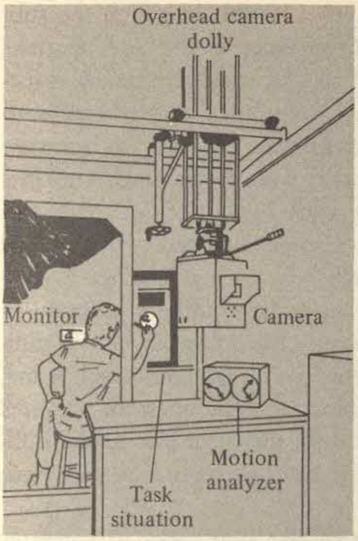
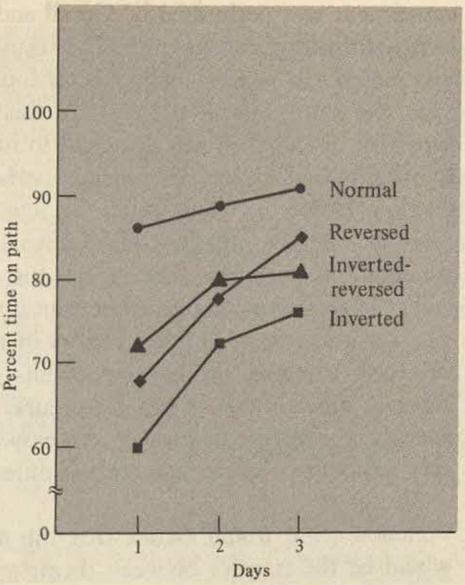


FIGURE 9.3 *Visual distortion with spectacles. (a) Note what happens when one looks through a prism with the base to the right. Because of the bending of the light rays, the object is seen displaced to the left. Furthermore, its vertical lines are bowed because light rays from different portions of the line pass through different thicknesses of the prism and, therefore, are bent different amounts. Moving the eye toward the base of the prism would increase the effect. (b) A simple lens of the sort used to correct for nearsightedness is in some respects like two prisms put together. If you look through the left side, the effect is similar to that obtained when looking through a base-left prism, as shown above. Looking through the right side of the lens produces the opposite effect. Looking through the center of the lens results in a balancing out of the two effects and no net distortion. However, the effects are obtained whenever you look to the left or the right, i.e., through the sides of the lens. The distortions are particularly noticeable with thick glasses but may only result in mild discomfort with mild prescription lenses. Based on Kohler, 1962.*

ously learned and, in turn, influences later learning. Unlike verbal learning (Chapter 8), however, when transfer effects occur they are almost always positive. Negative transfer is quite exceptional (Briggs, 1969). What this fact presumably means is that one almost always learns something in a given task that is useful in a subsequent task, and, furthermore, that whatever he learns that is not useful rarely if ever interferes with the later task. There are exceptions, of course, particularly where different responses are required in the same stimulus situation. At one point in time, shifting gears in cars with automatic transmission required looking at the gear-shift lever pointer to know whether you were shifting into low or reverse, since pulling the handle down in some cars would put it into reverse, while in others would put it into low. There are also several instances of aircraft accidents that



(a)



(b)

FIGURE 9.4 *The effect of inversion and reversal of visual feedback on performance. The experimental situation is described in (a). The subject cannot directly view his hand but sees an image of it on the television screen in front of him. The image may be normal, in which case left, right, and up and down are the same as though the subject were seeing his hand directly. It may also be inverted, in which case up and down are transposed, with left and right being left alone; reversed (left-right transposition, as in a mirror, but with no up-down inversion); or both inverted and reversed. In one experiment in (b) the subject attempted to trace the maze shown in the inset of the graph, with the results shown. Note that the various transpositions result in poorer performance, and that inversion of up and down is the most serious transposition.*
From Smith & Smith, 1962.

have arisen because a particular control was located in one place in one airplane, and a different, incompatible control located in that place in a different plane. Shifting from one to the other could result in negative transfer.

Given that we are dealing primarily with positive transfer, we find that the next question is concerned with the kinds of variables that influence the amount of transfer. Two variables that have some effect are the difficulty of the second relative to the first task, and the similarity between the earlier and later tasks in terms of the nature of the responses required and the patterns of skill required by each.

EFFECT OF TASK DIFFICULTY

Is there more transfer between an easy and a difficult task if the easy task comes first or if the difficult one is first? While the evidence is by no means unanimous, there is some indication that there is more positive transfer from a difficult to an easy task than vice versa. For example, an

experiment was performed by Gerall and Green (1958), in which the subject performed a tracking task. The frictional resistance in the control sticks was varied. In general, it has been found that the more frictional resistance, the more difficult the task. In this study, one group started out with low friction and then was switched to high, while the reverse was the case for the second group. In general, performance was better with the low friction. However, when initial training was with *high* friction, there was more transfer to the low friction condition than occurred when initial training was with low friction and the switch was to high. Other experiments have shown that whether transfer is better from difficult-to-easy, or vice versa, depends on other factors in the tasks. For example, if the difficult task contains all the components of the easy task and then some, superior difficult-to-easy transfer occurs. If, however, the operator acquires enough information in learning the easy task first, then transfer to the difficult task will be quite high and no differential transfer would be expected.

EFFECT OF TASK SIMILARITY

Common sense would dictate that the more similar two tasks, the greater would be the transfer between them; experimental results have borne this out. Adams (1954), for example, had his subjects perform a tracking task with the feet in which a downward movement of the foot pedal caused the controlled element to move downward. Then different groups of subjects were transferred to conditions in which the display was rotated by various amounts (see Figure 9.5) so that a downward motion of the feet caused the controlled element to move in a *different* direction. Although there was positive transfer for all groups, the least amount of it was found for the group in which the movement of the controlled element was completely reversed from that in training.

As mentioned previously, transfer from a difficult to an easy task is superior if the difficult task contains components of the easy task, or, in other words, if the easy task is completely similar to part of the difficult task. An experiment by Holding (1962) illustrates this principle. Subjects were trained in a tracking task in which the controlled element was driven away from the target by a signal that was composed of several different frequencies. These frequencies were put together in much the same way that a complex sound is put together from a series of simple sine wave frequencies (Chapter 5). One of the variables in the experiment was the bandwidth or range of frequencies included in the signal. His low bandwidth contained frequencies ranging from 0 to 0.29 hertz, and the three higher bandwidths contained frequencies of 0 to 0.58 hertz, 0 to 0.87 hertz, and 0 to 1.16 hertz, respectively. Notice that each successively higher bandwidth contained the frequencies present in the lower bandwidth. Subjects were trained with one of the bandwidths and then transferred to one of the others. In general, transfer was better when original training was on the higher bandwidths and transfer was to the lower ones than vice versa. In other words, whatever the subject learned in tracking the higher bandwidths was completely applicable to the problem of tracking the lower

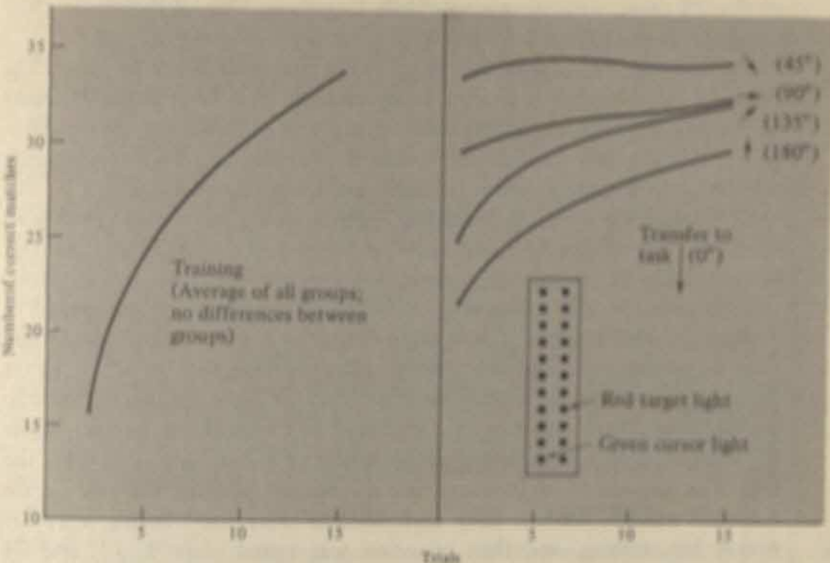


FIGURE 9.5

Transfer is more difficult when the relationship between stimuli and responses originally learned is reversed. In this experiment subjects depressed foot pedals to cause a green cursor light to be aligned with a red target light, as shown in the inset of the figure. The light panel was arranged so that for four different groups the green lights moved in four different directions, indicated by the arrows in the right panel. As shown in the left panel, the groups did not differ in terms of their performance on the original task. All groups, after being trained on the first task, were transferred to a second task, where the green lights moved down, i.e., in the same direction as the pedal movement. The four different curves in the right panel indicate that the more similar the direction of movement in training to the direction during transfer testing, the better the performance. Poorest transfer was when the direction was reversed.
Redrawn from Adams, 1954

ones. When shifting from lower to higher, however, the subjects had to learn something new—how to track the frequencies present in the new signal that were not present in the old one.

Retention of Perceptual Motor Skills

Think of some skill that you were at one time able to perform well but which you have not practiced for several years. Bicycle riding and skating are common examples. Then, the next time you get the opportunity, go riding or skating and note how much or how little of the skill was forgotten over the years. The chances are you will be surprised how well you do. The author tried this for roller skating after a retention interval of approxi-

mately 25 years, with surprisingly little forgetting. One of the major characteristics of continuous skills is that they are not easily forgotten.

On the other hand, retention of some discrete skills is not so good. The author has driven cars in the last several months that have gearshift levers on the steering column, on the floor, or a set of pushbuttons on the dashboard. After a few unsuccessful swats at the dashboard or the steering column or in the place where the floor shift was supppposed to be, he can usually locate the control. Forgetting, which took place rather quickly in this case, was obviously in the form of interference from other learning. Remembering to use the clutch pedal in a gearshift car is another example.

Laboratory studies of long-term retention of motor skills have tended to confirm the above points. For example, Fleishman and Parker (1962) had their subjects learn a complex compensatory tracking task in which (1) a dot on an oscilloscope had to be controlled in both the horizontal and vertical dimensions with a control stick, and (2) a needle on a meter below the scope had to be kept centered by means of a bar controlled with the feet. The measure of performance was the amount of error summed over a 6-minute practice session. Fifty such sessions were used during a 17-day period for training, and then retention was tested after 9, 12, and 24 months. Different subjects served in the different retention groups. The results are shown in Figure 9.6. As you can clearly see, there was practically no forgetting at all, even after 2 years. While *some* forgetting occurred, it only took a few minutes of practice for the old level of performance to be achieved. Similar results have been produced by other experiments.

Retention of discrete skills is another matter, as an experiment by Neumann and Adams (1957) illustrates. Their subjects were faced with two sets of eight switches each and had to learn which member of the second set went with each member of the first set. In other words, it was somewhat like a paired-associate task. They measured retention in terms of the number of trials to relearn the task to a criterion of two errorless trials in a row; their results are shown in Figure 9.7. There was some forgetting after 20 minutes, and progressively more as the retention interval increased to 1 year. Even so, you will note that a considerable amount of savings was demonstrated after 1 year, in that it took fewer trials to relearn them to learn originally.

In both of the experimental situations described above, as well as in the familiar examples first given, the retention was measured only after many, many trials in the learning situation. It would be of interest to know, particularly for a continuous task, whether more forgetting would occur after only one or a few practice trials. E. A. Bilodeau (1969) describes some experiments in which only one practice trial was permitted. The task he used was a simple one. The subject, who was blindfolded, had to position a lever by moving it through an arc of a certain number of degrees. Then he was told how far off he was. After a retention interval, which might be as much as several weeks, the subject was asked to recall either the original response that he made, the feedback that he was given, or the response that he *would have made* after the feedback was given in order to correct

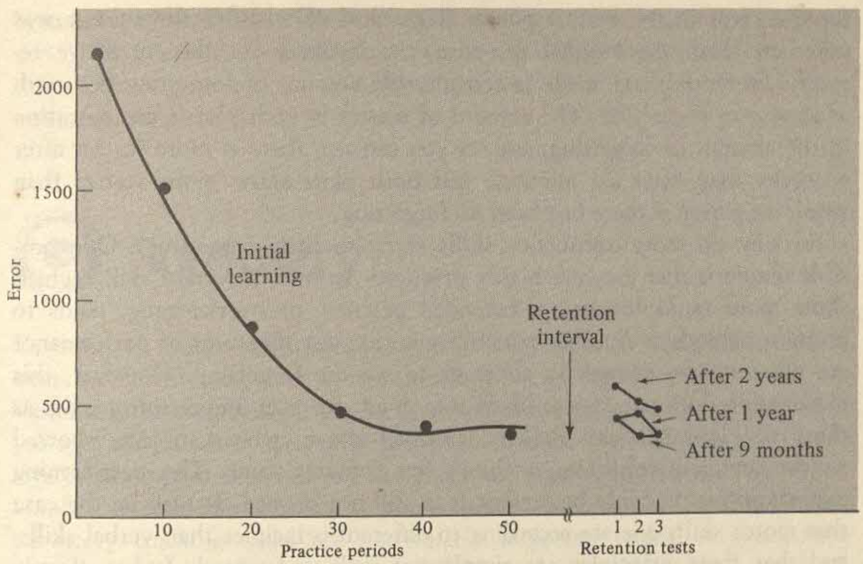


FIGURE 9.6 *Learning and retention of a complex tracking skill. Note that while initial learning took about 40 sessions, the skill was retained quite well after even 2 years. Redrawn from Fleishman & Parker, 1962.*

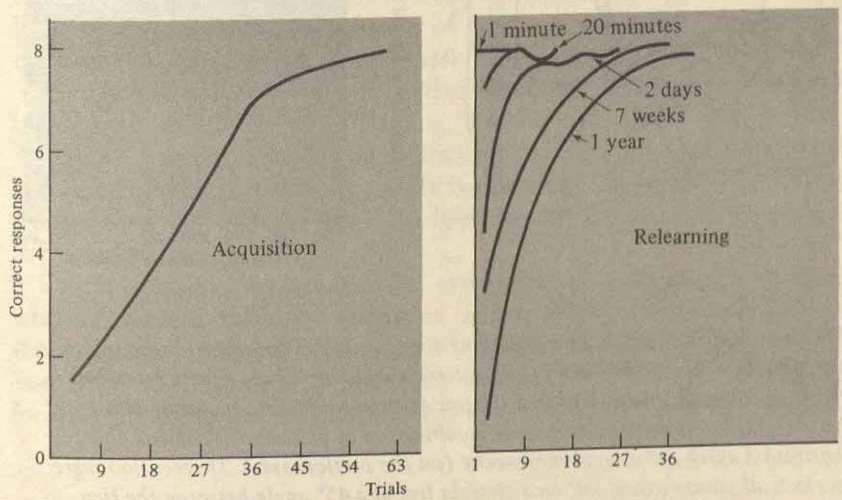
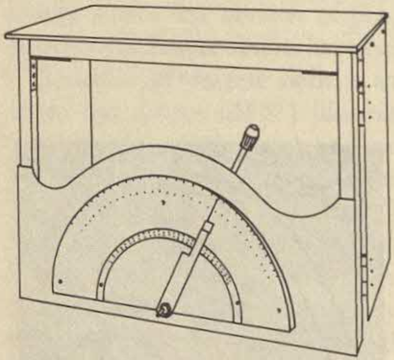


FIGURE 9.7 *Acquisition and retention of a discrete motor task, in which switches had to be actuated in pairs. The panel on the left shows initial learning, while the panel on the right shows relearning after varying retention intervals. Note that in contrast with Figure 9.6, a considerable amount of forgetting occurs. Redrawn from Neumann & Adams, 1957.*

for the error in the first response. Regardless of whether the subject was asked to recall the original response, the feedback, or the corrective response he would have made, a considerable amount of forgetting occurred, as shown in Figure 9.8. The amount of scatter in each plot is an indication of the amount of forgetting, and, as you can see, there is more scatter after 6 weeks than after 20 minutes, and both plots show more scatter than would be gotten if there had been *no* forgetting.

So why do most continuous skills show so little forgetting? One possible reason is that they are highly practiced. Even with verbal skills, which show more rapid forgetting, extended practice, or overlearning, tends to promote retention. Another possibility is that our measures of performance are not sensitive enough to allow us to see the forgetting. However, this explanation does not appear likely to account for such impressive results as those of Fleishman and Parker described above, whose subjects showed almost complete relearning within a few minutes' time. The overlearning explanation is probably better but it is still not proved. It may be the case that motor skills operate according to different principles than verbal skills, and that these principles are simply not well understood. It has already been pointed out that verbal processes play an important role in the early stages of motor learning, but they become less important as the skill



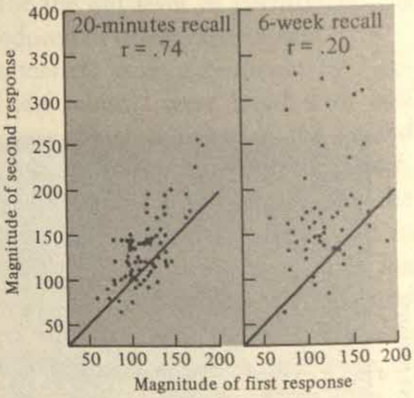


FIGURE 9.8 *One way of demonstrating forgetting of a motor skill. The subject made one response by moving the lever in (a) a certain amount. Then, after a retention interval, he made an attempt to duplicate that response. In (b), each data point on the graph represents a particular combination of first movement (on the horizontal axis) and second movement (on the vertical axis). If retention were perfect, all points would fall on a straight line at a 45° angle between the two axes. Thus the amount of forgetting is indicated by the scatter. Note that after a 20-minute interval the points tend to cluster around the line. However, after 6 weeks, there is much more scatter, indicated numerically by the correlation coefficient (r) between the first and second responses. The larger the coefficient, the less forgetting.*
From Bilodeau, Jones & Levy, 1964; and Bilodeau & Levy, 1964.

becomes well established. Perhaps the forgetting of the positioning response shown by Bilodeau after only one practice trial is primarily verbal forgetting. In any case, more thorough understanding of these processes must await further research.

Summary

Learning of motor skills involves the establishment of perceptual control over movements and their integration into complex sequences of behavior. Tasks may be classified on the basis of continuity (continuous or discrete), pacing (self-paced or externally paced), coherence (referring to the repetitive or nonrepetitive nature of the task) and complexity (according to the number of different elements in the response sequence). Pursuit and compensatory tracking tasks are particularly important types of continuous tasks, being involved in a variety of skills that adults perform.

Skill acquisition proceeds in phases in which the elements are first learned individually, then organized into larger units, with more and more precise control over the movements. Indications are that improvement would continue throughout life if motivational and aging factors did not intervene.

The most important factor affecting skill acquisition is feedback. Feedback may be primary, or inherent in the task itself, or secondary, i.e., added to the primary feedback. The more feedback there is, the better will be the learning. Both delay and distortion of feedback may affect learning, the extent of the effect depending on the task.

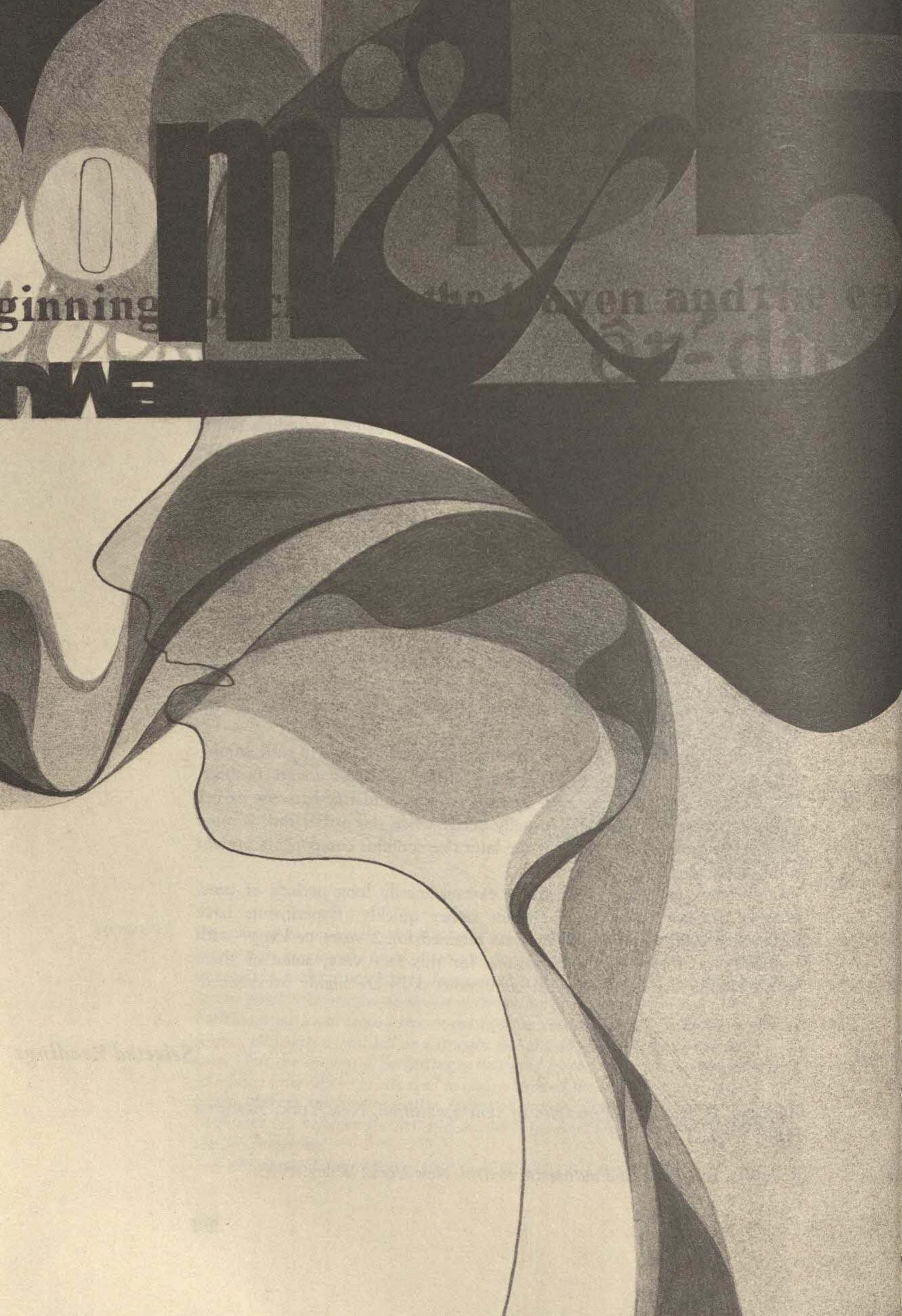
Transfer from prior learning is another important variable in skill acquisition. In contrast with verbal learning, transfer is almost always positive. The amount of positive transfer depends on the similarity between earlier and later tasks, and transfer is usually better when the earlier task is more difficult than the later one, and if the later one contains components present in the earlier one.

Continuous tasks are retained for extraordinarily long periods of time, whereas discrete tasks are forgotten rather quickly. Experiments have shown that a continuous skill may be retained for 2 years or longer with essentially no forgetting. Explanations for this fact vary, some of them focusing upon the fact that most continuous skills are highly overlearned.

Selected Readings

Bilodeau, E. A. (Ed.) *Principles of skill acquisition.* New York: Academic Press, 1969.

Kelley, C. R. *Manual and automatic control.* New York: Wiley, 1968.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Speech and Language

10

It is sometimes said that the major capacity that differentiates human beings from other animals is language—the capacity to communicate symbolically and flexibly with other members of the species. Whether or not this is the case, and we shall consider the matter further later on in this chapter, it is certainly clear that the generation and comprehension of language is one of the most important capabilities of modern man.

While speech is one of the two prime carriers of language, writing being the other, you should realize that speech is not language. Speech is an activity. One speaks, one listens and hears. One does not "lang." Whatever language one has is inside his head and inside the heads of everyone else who speaks his language. Speech may be understood in terms of the vocal apparatus that produces the sounds of speech and the perceptual processes that enable the listener to recognize the speaker's sounds. Language, however, is not such a simple matter. The fact is that you, and most other people who speak your language, have the capacity to generate an infinite number of sentences and to comprehend an infinite number of sentences generated by someone else. The problem here is to understand this infinite capacity, to develop a theory that explains why the capacity is so large and how it develops in the course of a human lifetime. That is not to say that speech production and hearing are well understood now. Indeed, there is much to be learned here. However, the problems seem somewhat more concrete and accessible than those of language.

We shall consider both topics in this chapter. First, we shall take up the problems of speech: the production and recognition of words. Then we shall discuss language, including the description and psychological relevance of grammar or syntax, and the psychological understanding of meaning. Of prime importance in both topics will be a consideration of their development from infancy to adulthood. Finally, we shall briefly consider some topics pertaining to the role of brain processes in speech and language.

Speech and Hearing

The Sounds of Speech

DESCRIBING THE SOUNDS

Speech sounds, like all other sounds, may be described in terms of the relative strengths of the different frequencies that comprise the sound (see Chapter 5). The difference between speech and, say, music, is that the speech sounds contain many more frequencies than musical sounds and they are not quite so systematically arranged. The best way to visualize speech sounds is by means of a *sound spectrogram*, one of which is shown in Figure 10.1. The speaker talks into a microphone and his output is passed through a set of filters, each of which allows only a small band of frequencies to pass through. The output of each filter then controls the brightness of a small lamp, which causes a phosphorescent band moving under it to glow. The brightness of the phosphor is proportional to the amount of energy coming through the particular filter, which, in turn, is proportional to the amount of energy in those particular frequencies contained in the speaker's speech. The result is what you see in Figure 10.1, with frequency being represented vertically on the phosphorescent band, intensity represented in terms of the brightness of the phosphor, and time represented horizontally.

TRANSIENTS, FORMANTS, AND PHONEMES

Speech sound waves may be divided into two parts: *transients*, which are very briefly occurring changes of frequency, and *formants*, which are more long-sustained sounds of particularly narrow bands of frequencies. The transients are consonant sounds, while the formants are vowel sounds. The different sounds are called *phonemes*, and there are approximately 40 phonemes in English speech. Some of them are shown in Table 10.1.

The different phonemes are determined by the shape of the mouth, vocal cavity, lips, etc., as the basic sound waves produced by the vocal cords pass through them. The particular part of the vocal apparatus responsible for a

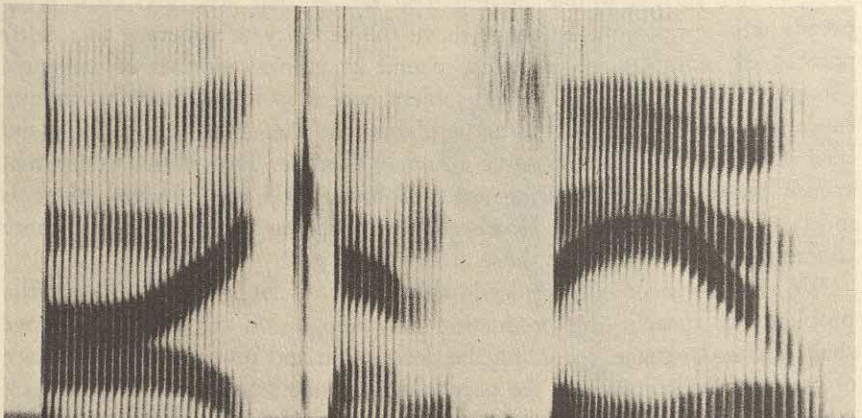


FIGURE 10.1 *A sound spectrogram of a speaker saying "I can see you." Courtesy of Haskins Laboratories.*

TABLE 10.1

Phonemes in general American English and their sounds

Phoneme	*Sound*	*Phoneme*	*Sound*
/ee/	heat	/b/	bee
/I/	hit	/d/	dawn
/e/	head	/g/	go
/ae/	had	/m/	me
/ah/	father	/n/	no
/aw/	call	/ng/	sing
/U/	put	/f/	fee
/oo/	cool	/θ/	thin
ʌ	ton	/s/	see
/uh/	the	/sh/	shell
/er/	bird	/h/	he
/oi/	toil	/v/	view
/au/	shout	/th/	then
/ei/	take	/z/	zoo
/ou/	tone	/zh/	garage
/ai/	might	/l/	law
/t/	tee	/r/	red
/p/	pea	/y/	you
/k/	key	/w/	we

Source: From Denes and Pinson, 1963.

particular phoneme is the basis for distinguishing that phoneme from others. Thus phonemes may be described in terms of a set of *distinctive features* (Jakobson, 1968). For example, a consonant may be dental (i.e., produced by positioning the tongue against the teeth), such as /t/ or labial (i.e., produced by the lips) such as /p/; palatal (produced by pressing the tongue against the hard palate), such as /s/ or velar (formed with the back of the tongue against the soft palate, or velum) such as /g/ or /k/. Vowel sounds may be narrow (/i/) or wide (/a/), to mention only one distinction. From the point of view of speech production, then, the distinctive features are basically *motoric* and *kinesthetic*, in the sense that particular muscles must be activated in order to shape the vocal parts to make the sounds and, through tactile receptors in the oral cavity, we feel what it is like to make a particular phoneme.

Speech Development

COOING AND BABBLING

During the first few years of a child's life, there is nothing quite so noteworthy, at least from his parents' point of view, as the utterance of his first word, which usually occurs at about 12 months of age. Although this event may be said to mark the beginning of linguistic development, it is also the end product of some rather significant maturational processes occurring during the first year. The newborn begins life being able to produce sounds from the back of the vocal cavity—coos, gurgles, and cries. As you might

expect from the proximodistal sequence of development described in Chapter 3, what happens during the first year is the gradual gaining of control over the front portions of the cavity. The progress is, then, from back to front, or, from the point of view of the body axis, from the inside out. Thus, the phonemes /k/ and /g/ come very early but /p/, which is made with the lips, develops rather late. While the back-to-front development is true for consonants, the opposite is the case for vowels. Front vowels, like /i/ and /u/, appear very early, while back vowels like /a/ must wait.

After about 6 months of age the infant has enough sounds to put together a considerable amount of babbling—repetitive consonant-vowel combinations like "gigigigigi." Both infant and parents seem to delight in this production, and it is usually highly reinforced. During this time more and more combinations are used as the front consonants and the back vowels become available.

THE FIRST WORD AND AFTER

When maturation has proceeded sufficiently to enable the vocalization of back vowels and front consonants, the first meaningful sound is uttered. *Regardless of the language spoken by the child's parents,* this "word" consists of a front consonant, either /m/ or /p/, and the back vowel /a/ (McNeill, 1970). While the resulting word, which may be either *"Mama"* or *"Papa,"* is probably not recognized as such by the child, it becomes a highly reinforced operant.

During the second year of life the course of development is exactly opposite that during the first year, at least for speech sounds. Starting with the back vowel/front consonant combination, the child gradually begins to employ in his speech vowels that are more and more in front, and consonants that are more and more in back. For example, instead of being able to say *come,* the child will first say *tum,* in which the consonant is made farther forward than it ought to be. Only later can he say the back consonant properly.

Another trend in the development of speech is the learning of correct and incorrect sound combinations. Different languages allow different combinations of sounds, and the child must learn those which are allowed within his own language community. For example, while "sporn" is not a word in English, it could very well be, because the sequence of sounds is pronounceable. "Kporn," however, is not and cannot be a word, even though the phonemes making up the sound are all in English (McNeill, 1970). At this point we cannot say very much about the process of learning to distinguish between correct and incorrect sound combinations, because research into this question is just beginning. There is some evidence (Messer, 1967) that children younger than four years of age can discriminate between words and nonwords when they differ with respect to only two or so phonemic features, but not much more can be said at the moment.

Speech Perception

How is it that the complex pattern of sound waves making up human speech is decoded into words, phrases, and sentences? To put the matter

a little differently: Suppose you were given the task of constructing a machine that would accept human speech as an input and then print out what was said. How would you go about doing it? Either way the problem is phrased, you have the problem of *pattern recognition.* That is, you must either postulate or invent some process or mechanism that will translate speech sounds into words. (We shall ignore for a moment the obviously important fact that speech is produced according to grammatical rules and is meaningful, and that the recognition of words is partly determined by their function within sentences and their meaning. These facts will be dealt with when we consider language later on in this chapter. What is important here is the more basic problem of the listener's putting together words out of speech sounds.)

SEGMENTATION

The following example makes it clear that the words are "put together" rather than passively recognized. If you have ever heard someone carry on a conversation in a foreign language, you were probably impressed with how rapidly they were speaking, and how the words seemed to run together. In contrast, when you listen to English, you do not get that impression at all. Even when someone speaks rapidly, you usually hear individual words and phrases, each word more or less standing out. If you were to examine a large number of sound spectrograms of foreign speech and compare it with native speech, you would find very little difference in either the speed or the running together of words. The sounds from one word usually run right into the next word, and there are at least as many pauses within words as there are between them. In other words, *the pauses that you hear when listening to your native language are not really there.* Words appear to stand out because the *listener* makes them do so. The technical term for this process is *segmentation.* The reason foreign speech seems fast is that you, the listener, have not learned to segment such sounds.

THEORIES OF SPEECH PERCEPTION

The problem, then, which is not yet solved, is to specify the process whereby the more or less continuous sounds of speech are categorized into words that stand out from one another. A number of possible solutions have been offered in the form of theories of speech recognition.

Template Matching. One possibility is that, through learning, we acquire a set of "templates" corresponding to words. Each sound would then be compared with each template that the listener has acquired, and the one that fits best would be selected as the word to be perceived. The problem with this template-matching model is that people know too many words, and the matching process would take entirely too long. Furthermore, it would be difficult to conceive of templates that would accurately categorize words spoken in the several different dialects that the average listener is able to understand.

Feature Extraction. Another possibility is that processes within the listener extract certain distinctive features out of the sound pattern, for instance,

phonemes. The different phonemes certainly sound distinctive enough, and perhaps particular phonemic patterns represented in the speech sound wave are extracted by the listener. The difficulty with this view is that the same phoneme is represented by a different pattern of frequencies within the speech wave, depending on the other phonemes present in the syllable being uttered. The consonant phoneme /d/, for instance, is shown in Figure 10.2 when it is followed by various vowels. For each case you have a different pattern of transients leading into the vowel formant. Thus you may be unable to find the distinctive pattern of frequencies in the sound wave that corresponds to the consonant sound /d/. It is hard to see how such variable "distinctive features" could be the basis for speech recognition.

The Motor Theory. Earlier in this chapter it was pointed out that there are clear-cut, distinctive differences between the various phonemes in terms of where they are produced in the vocal cavity, and how it feels to produce them. This point has led some investigators (e.g., Liberman et al., 1967) to suggest that speech may be recognized in the following way: A sound pattern is input to the listener's auditory system. He attempts (unconsciously) to produce a sound which matches that sound. In the process of production he responds to the phonemic distinctive features which, as indicated above, are present in the production of sounds. These motor and kinesthetic features, then, provide the basis for recognition of speech. This so-called motor theory of speech perception thus says that speech is recognized by the same process which produces it.

Analysis by Synthesis. It is not necessary that actual speech movements be made in order for speech to be recognized. In fact, Lenneberg (1962)

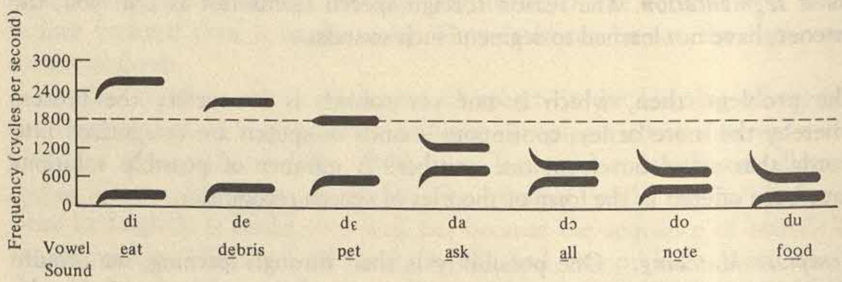


FIGURE 10.2 *Sound patterns that sound like various syllables. Each syllable begins with the consonant phoneme /d/, and ends with a vowel. The consonant part of the sound is determined by the two transients, each leading into a formant, or sustained sound in a narrow frequency range. The vowel part of the syllable is determined by the pattern of formants. Notice that the consonant transient required is different for the various syllables, particularly the transient leading into the second (higher) formant. In other words, there does not appear to be a unique part of the speech wave that corresponds to a particular consonant phoneme. How a particular transient will sound depends not only on its properties, but also on the nature of the formants that follow it.*
From Liberman, Cooper, Shankweiler, & Studdert-Kenedy, 1967.

reports a case of a child who could understand speech quite well, although, because of a disorder in the speech production system, he could not speak at all. Actually, all that may be required is that the parts of the central nervous system that ordinarily are involved in speech production respond *as if* the sounds were going to be produced. In other words, the "production" of the sound to match the input would be presumed to take place vicariously in the brain. (To understand how this notion might work, simply imagine yourself saying the word *house*, but without actually saying it.) This view, that speech is recognized by implicitly producing it, is known as "analysis by synthesis" (Stevens & Halle, 1967).

We do not know exactly how speech is recognized. The four alternatives mentioned—template matching, feature extraction, the motor theory, and analysis by synthesis—have all been suggested at one time or another as theories of how the process occurs. A more definitive understanding of the process must await further research.

Language

Language can best be defined as a set of rules that people acted as though they knew. The rules are not all known as yet, but many investigators feel they must exist because of the ability to discriminate grammatical from ungrammatical sentences and meaningful from unmeaningful utterances. Consider the following three sentences:

1. John psychology and reading was textbook the asleep fell.
2. The psychology textbook was reading John and fell asleep.
3. John was reading the psychology textbook and fell asleep.

You will no doubt recognize (3) as a perfectly grammatical sentence and (1) as a meaningless string of words. (2) could be a sentence, but the direct object and the subject are reversed such that the meaning expressed is anomalous. The psychology of language is concerned with understanding how it is you were able to make the distinctions between the three sentences above, and to produce and recognize an infinitely large number of other sentences. We shall consider the problem under two headings: *syntax*, which is concerned with grammatical relations between words, and *semantics*, which is the study of meaning.

Syntax

Grammar, you may say, is something you have to learn in English classes. What does it have to do with psychology? Actually, it is only in the last 15 or 20 years that psychologists have been interested in grammar. One reason for this interest is that linguistic competence plays a major role in language behavior, which, you will probably agree, is an extremely important aspect of human behavior in general. Another reason is that recent

theoretical developments within the field of linguistics have provided a meaningful framework within which psychologists could work. The theory referred to here, called transformational grammar, will be described presently.

WORD ORDER

The grammaticalness and meaningfulness of sentences is largely dependent upon word order, as the three sentences about John illustrate, and any understanding of language behavior that we have must eventually explain how words get into the correct order. One possibility for explanation relates to the fact that there are *sequential dependencies* within English (or any other language) such that, given the first word in a sentence, the selection of the second word is distinctly limited. Given the first two words, the selection of the third word is even more limited, and so on. For example, given the word *the*, you know that the next word must be a noun, adjective, or adverb. It may not be a preposition, conjunction, or a verb (except perhaps a participle serving the function of a noun). The effect of these implicit rules that limit word order were already seen in Chapter 8, in which memory for word sequences representing various approximations to English was discussed. Word order is clearly an important aspect of language.

A process that utilizes sequential dependencies in the manner described above, i.e., in which the probability of each successive item is determined by the preceding items, is called a *Markov* process. It has been suggested (e.g., Skinner, 1957) that language behavior reflects the operation of such a process. There is a problem with this view, however, arising from the fact that sentences may consist of phrases embedded within phrases. For example, consider the sentence "The man who called you on the phone yesterday about the ad you placed in the paper is waiting outside." The distance between the verb *is* and its subject, *man*, is 16 words, two of which are verbs that *could* very well go with *man*. Deciding whether or not the sentence is grammatical requires, among other things, that one be able to recognize that *man* and *is* are part of the same phrase and that they agree in number. Changing *man* to *men* or *is* to *are* would render the sentence ungrammatical. A Markov process would have to test *man* against each of the intervening words and decide whether each is the verb that goes with *man*. If, as has been suggested by the two investigators who originally made this point (Miller & Chomsky, 1963), each intervening word might be one of four grammatical categories, then there would have to be 4^{16} (about 4 billion) different probabilities learned in order to deal with that sentence. Since there are only about 31.5 million seconds in a year, and if *at most* only one probability could be learned per second, it would take around 125 years to learn enough to decide whether that sentence was grammatical or not. Clearly, an alternative is called for.

TRANSFORMATIONAL GRAMMAR

One alternative that has generated a great deal of interest in psychology is the theory of transformational generative grammar developed by the linguist Chomsky (1957, 1965). Although we cannot go into much detail

here about the theory or its applications, you should be able to get some idea as to what it is about from the following discussion.

One way of explaining sentence generation and comprehension is to say that speakers and listeners have a set of *rules* for generating correct sentences. A rule is an abstract principle that applies to a large number of specific instances. A rule for sentences might be the following: "A sentence consists of a noun phrase and a predicate phrase," or, in symbolic notation,

$$S \rightarrow NP + Pred\ P$$

where the arrow may be interpreted "may be rewritten as." Additional rewrite rules would specify that "A predicate phrase consists of a verb and an optional noun phrase," and "A noun phrase consists of a noun and an optional article, or adjective." Symbolically, these rules may be expressed as

$$Pred\ P \rightarrow V + (NP)$$
$$NP \rightarrow N + (art) + (adj)$$

The use of these three rules in generating a simple declarative sentence is shown in Figure 10.3, which shows a diagram indicating the relationship between the parts of the sentence. A dependent clause may be embedded in the sentence by the use of the same rules that generated the original sentence, plus the additional rules for substituting a sentence for an adjective and a pronoun for a noun:

$$Adj \rightarrow S$$
$$N \rightarrow Pro$$

This relationship is also shown in Figure 10.3.

Diagrams such as those depicted in Figure 10.3 are known as *phrase markers*, and it is possible to construct a phrase marker diagram to describe the structure of any sentence. Furthermore, application of rewriting rules such as those indicated above will enable one to generate an infinite number of grammatically correct sentences, including those in which clauses are embedded within clauses. Psychologists working within the framework of transformational grammar have suggested that accomplished speakers act according to these rules, thereby being able to speak grammatically. In other words, it has been suggested that *every person, whether he is aware of it or not, has learned these rules, in the sense that he speaks as though he knows them.* As you will see later, there is evidence from studies of speech in young children that the rules develop at a very early age.

Surface Structure and Deep Structure. There is at least one problem, however. Consider the sentence "They are eating apples." (Neisser, 1967). Its meaning is ambiguous because, without knowing what the speaker has in mind, you do not know whether "eating" is what is being done to the apples, or whether it is an adjective describing a particular kind of apple. The structure of this sentence as indicated by a phrase marker diagram could be one of two kinds, shown in Figure 10.4. Ambiguities such as this have led to the distinction between *surface structure* and *deep structure.* Surface

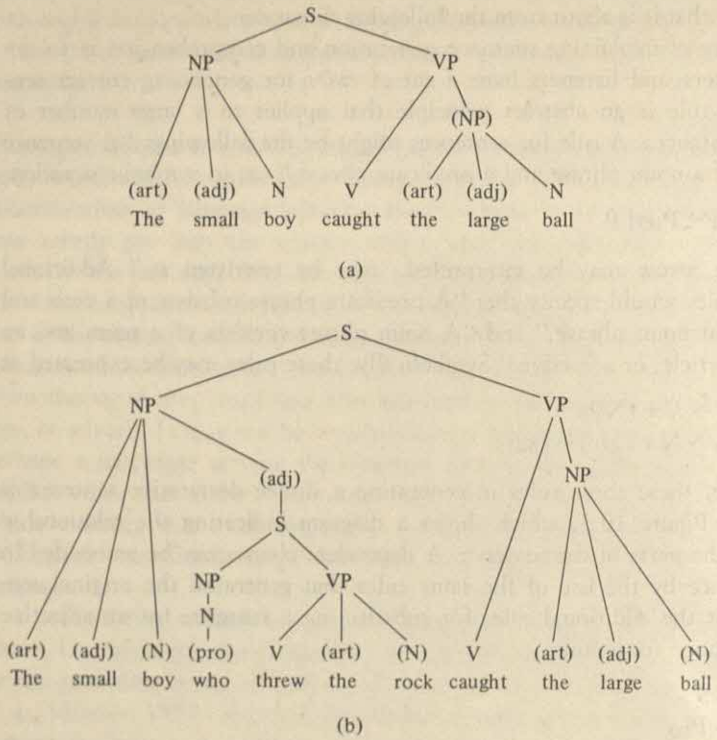


FIGURE 10.3 *Phrase markers for the sentences (a) "The small boy caught the large ball," and (b) "The small boy who threw the rock caught the large ball." In the latter sentence the dependent clause was generated by the use of two additional rewrite rules, one indicating that a sentence may substitute for an adjective, and the other indicating that a pronoun may substitute for a noun.*

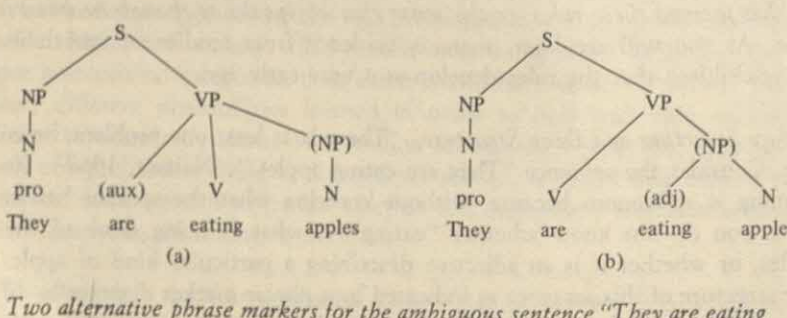


FIGURE 10.4 *Two alternative phrase markers for the ambiguous sentence "They are eating apples."*
Neisser, 1967.

structure is what is described in the phrase marker diagrams in Figures 10.3 and 10.4. Deep structure is what the speaker has in mind. In the case of "They are eating apples," the deep structure might include the simple declarative sentence "They are apples," with *eating* as a modifier, or the sentence "They eat apples," with *are* as an auxiliary verb, but not both.

Just as the surface structure of some sentences does not adequately specify deep structure, so a given deep structure may be represented by several different surface structures. The two sentences "He purchased the small car," and "The small car was purchased by him" have the same meaning, or deep structure, but they differ in surface structures. The two surface structures are shown in Figure 10.5. The deep structure, or meaning of the two sentences, may perhaps best be represented as a simple declarative sentence, the first one given above. The second sentence, which expresses the same idea but in the passive voice, may be related to the first by a *transformation rule*, which indicates how to change an active sentence to the passive voice. The two deep structures are also shown in Figure 10.5. A second transformation could be employed to change the sentence into a negative one, "The small car was not purchased by him," as is shown in the same figure.

The two transformation rules mentioned above, "passive" and "negation,"

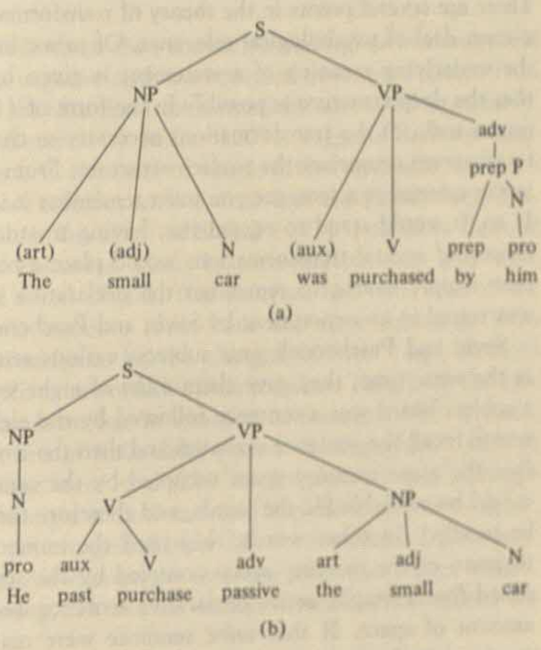


FIGURE 10.5

Surface structure (a) and deep structure (b) of the sentence "The small car was purchased by him." Note that the deep structure is in the form of an active declarative sentence. Two transformations are involved. One of them changes the tense of the verb (represented as an auxiliary in deep structure) and the other one (represented by the adverb, indicating passive tense, i.e., how the purchase was made) changes the sentence from active to passive.

serve the function of relating surface structure to deep structure. Actually, they are only two of a complex network of transformation rules which, according to the theory of transformational grammar, serve to relate surface structures to deep structures in the English language. There is no point in even attempting to elaborate these rules here. The main idea you should get is that many psychologists working in the field of language think that individuals can generate and understand sentences because in some fashion they have a grasp of the necessary phrase structure and transformation rules, and they are able to apply the rules in an automatic, unconscious, or intuitive fashion.

To summarize for a moment, language competence may be explained either in terms of the learning of correct sequential dependencies between words, or the learning of rules that provide for the generation of sentences. Although some psychologists may feel that the learning of all the sequential dependencies could not possibly occur in any one lifetime, others feel that the learning of all the complex phrase structure and transformational rules is equally unlikely. It may be that neither view will turn out to be adequate. Clearly, much work needs to be done in order to increase our understanding of language behavior.

THE PSYCHOLOGICAL REALITY OF GRAMMAR

There are several points in the theory of transformational grammar that have a great deal of psychological relevance. Of prime importance is the idea that the underlying meaning of a statement is given by its deep structure, and that the deep structure is possibly in the form of (1) simple declarative sentences and (2) the transformations necessary to change the simple sentences to whatever comprises the surface structure. From this view, if you are trying to remember a sentence you must remember it in its deep structure form. If so, it would stand to reason that having to store both a declarative sentence *and* several transformations would place a heavier burden on memory than simply having to remember the declarative sentence itself. This idea was tested in an experiment by Savin and Perchonock (1965).

Savin and Perchonock gave subjects various sentences to remember and, at the same time, they gave them a list of eight words to remember. What a subject heard was a sentence followed by the eight words, after which he was to recall the sentence verbatim and then the words. The authors assumed that the more memory space occupied by the sentence, the less space that would be available for the words, and therefore the fewer words that would be recalled. In other words, they used the number of words recalled as a measure of the memory space occupied by the sentence. They further reasoned that a simple, active declarative sentence would occupy the minimum amount of space. If that same sentence were made passive, the active to passive transformation would require additional space. If the sentence were made negative as well, then even more space would be required for the negative transformation. In other words, the more transformations, the more memory space occupied, and the fewer words recalled. Examples of the various transformations used as well as the results in terms of words recalled are given in Table 10.2. As you can see, the passive sentence and the nega-

TABLE 10.2

Word recall for sentences requiring various transformations from deep to surface structure

Sentence Type	*Example*	*Mean Number of Words Recalled*
Active declarative	*The boy has hit the ball.*	*5.27*
Wh-question	*What has the boy hit?*	*4.78*
Question	*Has the boy hit the ball?*	*4.67*
Passive	*The ball has been hit by the boy.*	*4.55*
Negative	*The boy has not hit the ball.*	*4.44*
Negative question	*Has the boy not hit the ball?*	*4.39*
Emphatic	*The boy* has *hit the ball.*	*4.30*
Negative passive	*The ball has not been hit by the boy.*	*3.48*
Passive question	*Has the ball been hit by the boy?*	*4.02*
Negative passive question	*Has the ball not been hit by the boy?*	*3.85*
Emphatic passive	*The ball* has *been hit by the boy.*	*3.74*

Source: From Savin & Perchonock 1965.

tive sentence occupied more space than the active declarative sentence, and the combined passive and negative sentence occupied even more space. Thus there is some support for the idea that transformations are stored in memory.

Another experiment, this time by Sachs (1967), suggests that the long-term storage of sentences is in the form of simple active sentences, and that the transformations to more complex surface structures are quickly forgotten. In her experiment, which is described in Slobin (1971), subjects listened to passages of connected discourse. Next, in a recognition test they were given a test sentence and asked whether that sentence had been read in the previous passage. The test sentence could have the same meaning (deep structure) as the original sentence but be changed in form (e.g., changed from active to passive voice or reworded within the same voice), or the sentence could have the same form but be changed in meaning. The test sentence was presented after one of three delay periods during which 0, 80, or 160 syllables of the passage were read. The results showed that although subjects could recognize changes in both meaning and form after zero delay, the formal changes were not recognized after 80 or 160 syllables. However, the subjects easily recognized changes in meaning after the longer delays. In other words, the meaning, but not the surface structure, was stored for the longer period of time.

What these two experiments suggest is that the notions of transformational grammar may in fact represent the way humans process information. Indeed, it has sometimes been suggested that deep structure actually is the basis for symbolic thought as well as the meaning of sentences.

As you might imagine, however, there are alternative interpretations. Alan Paivio (1971), for example, feels that memories of the sort that could

be described by simple, concrete active sentences are stored in the form of imagery, rather than as words, and that grammar is important only in that it makes clear who or what is doing the acting (i.e., the subject of the sentence) and who or what is acted upon (i.e., the direct object). This issue will be discussed further in the next section, which deals with meaning. At this point it can simply be stated that, like most other issues we have been discussing, it remains to be resolved. Two final illustrations do indicate, however, that grammar in and of itself provides a framework within which even meaningless utterances are remembered. Consider the following verse from Jabberwocky, a poem in *Through the Looking Glass*, by Lewis Carroll (1965, p. 18):

'Twas brillig, and the slithy toves,
  Did gyre and gimble in the wabe:
All mimsy were the borogroves,
  And the mome raths outgrabe.

Although the meaning is likely to escape one, it is easy to learn because it seems to be grammatical and it rhymes. An experiment by William Epstein (1961, 1962) compared the learning of nonsense "sentences" like "A vapy koobs desaked the citar molently um glox nerfs," with the same nonsense words, omitting the articles and the functional suffixes: "vap koobs desak citar molent um glox nerf." As you might expect, the first string of words was easier to learn than the second, presumably because of the apparent syntax provided by the articles and suffixes.

Semantics

Semantics is the study of meaning. Language has meaning, or else people would not spend so much time engaging in it. Meaning is what is communicated by language, whether the communication be by means of speech, gestures, facial expressions, manual signs, etc. The term is quite pervasive. You ask, "What did you mean by that statement?" "What is the meaning of that poem?" "What did that look mean?" "What I mean is, . . ." Clearly, the problem is quite central to the study of language, and also to the study of thinking, which will be taken up in the next chapter.

What is meaning? The question has been confronted throughout the ages, at least as far back as 500 B.C., when the poet Simonides (who is given credit for developing the method of locations, described in Chapter 8) suggested that the meaning of a particular statement was related to the imagery evoked by it. It is still being confronted today, and the issues are by no means resolved. Some approaches stress the importance of imagery for meaning, others the importance of verbal associations. Still other approaches stress the central role of tendencies to action, i.e., the meaning of something is carried by your tendency to interact with it in some particular way. Some approaches attempt to integrate these ideas.

Whatever the approach, you should realize that meaning is a *construct*, not a thing. It refers to the fact that we regard events as being related to one another, and these relationships are somehow represented in our experience and partially determine how we respond to any particular event. Thus it is a broadly based construct, applicable in a variety of situations, and it would be too much to expect complete agreement as to how best to understand it. In this section we shall consider meaning as imagery, as a set of verbal associations, and as a set of semantic features. Then we shall consider briefly the problem of the measurement of meaning.

IMAGERY

Images are internal processes that have a perceptual quality to them. Apparently they are more vivid in some people than in others, and may be mostly visual, mostly auditory, mostly kinesthetic, or some combination. Think of the meaning of the word *dog*. What comes to mind? You may picture some particular dog, or have an image which represents some of the general characteristics of a dog but not any particular dog. Or, your inner representation may have no visual qualities whatever, and be primarily auditory or tactual —what a dog sounds or feels like. On the other hand, what comes to mind may not be a concrete representation at all, but some words that define dog, relate it to other animals, etc. To the extent to which the word evokes imagery as opposed to words, to that extent you might say that the meaning of the word *dog* is carried by imagery.

As indicated above, imagery has played a major role in attempts to understand meaning for about 2500 years at least. The trend was reversed by the behaviorist John B. Watson, who felt that images bore no functional relationship to anything of importance to meaning. As a result of Watson's influence the matter was dropped for about 50 years until just recently, when there has been a renewed interest in imagery as a basis for meaning. The difference between the earlier and the present approaches lies in the experimental nature of the modern approach. Paivio (1971), who has played a major role in the revival of this interest, describes a number of experiments attempting to elaborate the role of imagery in cognitive and linguistic processes.

What role does imagery play as a carrier of meaning? An experiment by Huttenlocher, Eisenberg, and Strauss (1968) is illustrative of one approach to this question. The authors had children listen to sentences such as "The red truck is pushing the green truck," or "The green truck is being pushed by the red truck." They measured the time required to comprehend the sentence by measuring the amount of time it took the child to place one of the trucks in the appropriate position relative to the other one, which was fixed in place. The truck in the child's hand could be either the logical subject of the sentence or the logical object (i.e., is doing the pushing or is being pushed). When the sentence, however, is passive, the logical object is the grammatical subject, and vice versa. (Think this one through yourself.) Their results indicated that reaction time was faster when the truck in the child's hand was the logical subject, regardless of whether the sentence was active or passive. The authors suggest that their children imag-

ined the action expressed in the sentence, and that the imagining process was easier if the movable object (i.e., the child's truck) was doing the acting. In another experiment (Huttenlocher, 1968) three runners, A_1, A_2, and B were described in terms such as A_2 is being led by A_1 and B is leading A_1. Who is in front? They were better able to evaluate B's position when B was the logical subject of the sentence. They also reported that they solved the problems by imagining the spatial relationships between the three runners.

Paivio's point is this: At least for concrete words or statements, imagery makes up a significant portion of the meaning. Verbal meaning is also present, which has led him to suggest what he calls a "dual process" theory of meaning. That is, the meaning of concrete terms has two components: images and verbal associations. The meaning of abstract words and phrases is almost exclusively in terms of verbal associations, to be discussed below.

ASSOCIATIONS

What is the first word that comes to mind when you hear the word *dog*? What about *chair*? What about *religion*? Any word you can think of will no doubt cause you to think of some other word or words that is associated with it. Psychologists have been fascinated with word association for a long time. For instance, Sir Francis Galton (1883) thought that associations "lay bare the innermost reaches of the mind," and refused to print some of his own associations. The fact that many people give the same associations to many words, particularly common ones, has led some psychologists to suggest that associations are the basis for meaning. That is, the meaning of a given word is the pattern of verbal associations evoked by it. Words that mean approximately the same thing would presumably evoke about the same words as associates. James Deese (1965) of the Johns Hopkins University has adopted this point of view in his concept of *associative meaning*. If a set of words is examined with regard to the associations elicited by each, interesting patterns often emerge. The words *moth* and *butterfly*, for instance, tend to evoke many associates in common, and therefore can be said to have a great deal of commonality in meaning by virtue of their *associative overlap*. Words with no associative overlap presumably have no common meaning. By and large, words tend to exist in clusters of associates that are bound together by one of two processes: *grouping* (i.e., the putting together of items that are alike in some way) and *contrast*, by which words that mean the opposite are put together.

Both imagery and association as approaches to meaning have the common feature that meaning is given by an *internal response* which *mediates* further responses to the word. Psychologists differ as to whether they think the primary mediating process is mostly nonverbal (i.e., imagery) or verbal (associations), and some, such as Paivio (mentioned previously) recognize both processes. It is important to note that both approaches have focused more or less on the meaning of *single words*. Although the imagery approach has also concerned itself with sentence meaning (c.f. above), the majority of experimental approaches has utilized single words.

SEMANTIC FEATURES

Meaning, however, depends very heavily on sentences. The meaning of a given word can be seen to shift depending on the sentence in which it appears. Slobin (1971, p. 85) gives this example:

"I would have taken the plane but it was too heavy to carry." As you can see, the meaning of the word *plane* depends upon the second half of the sentence. You can think of numerous other examples. Just consider, for instance, the number of sentences you can make up using the word *take*, in which the meaning of the word is quite clear from the context in which it is used, but quite different from sentence to sentence. Any word may have a number of *semantic features* more or less like the entries you see in a dictionary. Of all the semantic features of the word *take*, the particular ones applicable in a given sentence depend on whether it is used as a noun or a verb, on the nature of the direct object if it is used as a verb (i.e., to take a course, or to take $5), etc. The function of the context in which a word is seen is to narrow the possible range of semantic features which are applicable. How this task is accomplished is not at all well understood, for we are left with the question as to *how the context itself is understood*. If the rest of a sentence is necessary for understanding the meaning of the word *plane* above, then what provides the meaning of the rest of the sentence? As has been said before, and will be said many times again, we must await further developments in the field.

NONVERBAL CONDITIONED REACTIONS: THE SEMANTIC DIFFERENTIAL

Charles Osgood (1953) has suggested that meaning be considered as a set of nonverbal internal reactions that come to be evoked by the word through a process of conditioning. The word, then, is a CS for this internal pattern of responses, which is the CR (and the meaning). This idea has led to the development of a method for measuring meaning, called the Semantic Differential (Osgood, Suci, & Tannenbaum, 1957). The rationale is that words which tend to evoke some of the same internal reactions will have some meaning in common. The Semantic Differential consists of a set of bipolar adjectives such as those shown in Figure 10.6. A word is presented, and the subject indicates where the meaning of the word seems to stand relative to each of the adjective pairs. The profile shown in Figure 10.6 for the word *polite* is one way of describing the meaning of that word.

The information in the scales may be further reduced. Osgood and his co-workers have shown through numerous studies that most bipolar adjective scales may be reduced to three basic factors: evaluative (good-bad), potency (strong-weak), and activity (active-passive). They feel that the connotative meaning of any concept may be adequately expressed by its score on each of the three major factors.

The Development of Language

Language development begins with the first word, which may occur at about 12 months of age, and continues at least into adolescence. In recent years it has been a topic of great interest to researchers, who have spent

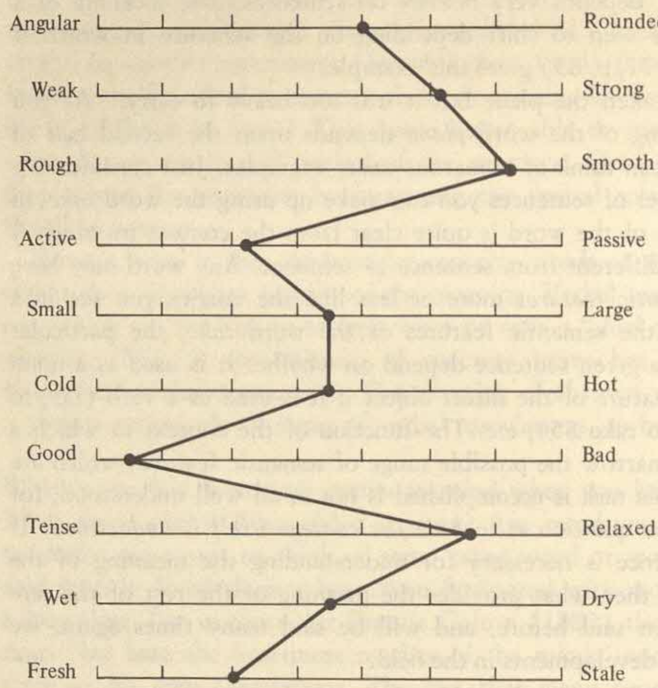


FIGURE 10.6 *A semantic differential profile for the word* polite. *Subjects rated the word on each of the 10 bipolar scales indicating, for example, exactly where* polite *fell on the dimension defined by the words* angular *and* rounded. *The profile shown is an average of a group of 20 subjects. Another similar group produced a profile that was practically identical to this one.*
From Osgood, 1952.

hours recording and listening to the speech of children at various ages. From these records have come most of the present notions about how language develops.

If one simply determines the length of utterances made by children (measured in terms of morphemes, which are the smallest unit of meaning; for example, the word *cat* and the suffix "ing" are both morphemes), there appears to be a sharp increase in length of utterance with age. Developmental curves for three children studied by Roger Brown and his colleagues (1969) are shown in Figure 10.7. Brown has suggested that the mean length of utterance be used to define five stages of development, also indicated on the graph.

The earliest utterances consist of one-word "phrases" which seem to carry the meaning of whole sentences. For this reason the speech is said to be "holophrastic." Although one will never know precisely what a baby means when he utters a word, some investigators have come to the conclusion that the single word uttered at this stage carries with it the meaning of a complete sentence, or at least a phrase. The word may be a comment on something or an emotional expression or both. For example, in one

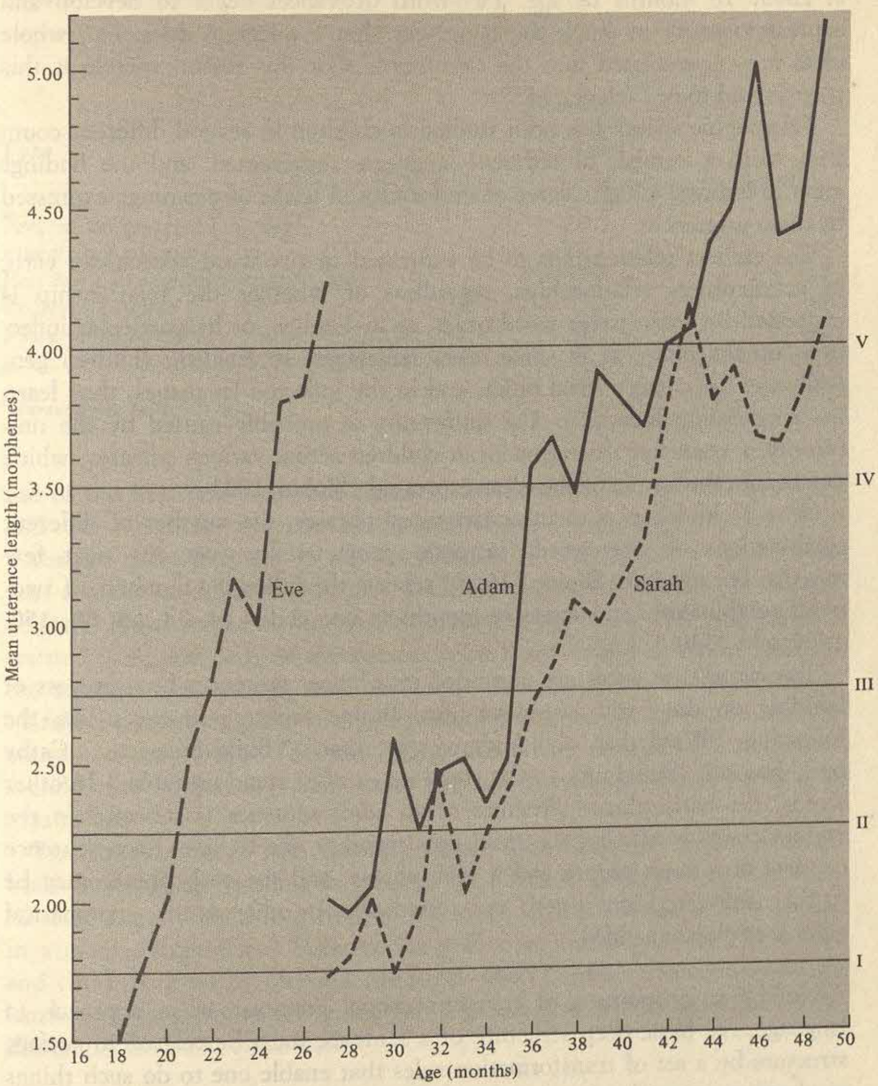


FIGURE 10.7

Language developement in three children. The mean utterance length increases markedly with age, although the three children began developing at different ages. *Brown, Cazden, & Bellugi-Klima, 1969.*

investigation conducted by the linguist Leopold on his own daughters (cited by McNeill, 1970), the word *Mama* meant *food*, and also *tastes good*, judging from the situations in which the word was used. The point is that the baby may comprehend more than it is capable of expressing, due to phonological limitations, and one word must serve many functions.

TELEGRAPHIC SPEECH

We may talk of grammatical development only when the child begins to string two or more words together, since grammar pertains to the usage of words together. This stage, which is still part of Brown's first stage, begins

at about 18 months of age. Two-word utterances begin to develop and express meaning in much the same way that a telegram does, i.e., whole ideas are encapsulated into the two words. For this reason speech at this stage is said to be "telegraphic."

Telegraphic speech has been studied in children in several different countries, with a number of different languages represented, and the findings seem to indicate a high degree of uniformity in terms of meanings expressed by these utterances.

The earliest relationships to be expressed in two-word speech are verb, or action-object relationships, regardless of whether the relationship is expressed by a consistent word order, as in English, or by particular inflections on the noun, as in some other languages. In English, children generally use the correct word order, and in the inflected languages, they learn the appropriate inflection. The uniformity is probably caused by the uniformity in cognitive development in children across various cultures, which determines the nature of the ideas expressed (Slobin, 1971).

Once a child begins to utter two-word phrases, the number of different combinations of two words increases geometrically over the next few months. For instance, Braine (1963) reports the following numbers of two-word combinations in successive months in one child: 14, 24, 53, 89, 350, 1400, and 2500.

Two-word utterances are expanded into longer sentences by a process of building on the basic two-word unit. Braine reports sequences like the following: "Want that . . . Andrew want that." "Build house . . . Cathy build house." "Stand up . . . Cat stand up . . . Cat stand up table." In other words, the basic phrase structure of an adult sentence is reflected in the various components that the child puts together one by one. Each sentence consists of a noun phrase and a verb phrase, and the verb phrase may be further elaborated into a verb and a predicate. In other words, grammatical rules are being expanded.

LEARNING OF TRANSFORMATIONS

According to proponents of transformational grammar as an approach to language, the basic deep structure of a sentence must be related to surface structure by a set of transformation rules that enable one to do such things as pluralize; state the possessive; and distinguish between first, second, and third person endings for verbs. In general, the inflections of a given language may be described as a set of such rules. Other rules pertain to negation, asking questions, and putting together sentences with independent and dependent clauses which, by themselves, could be sentences. The application of these rules begins to be made in Stage II, when the mean length of utterance increases above 2.0, and continues for many months thereafter.

There has been some study of the development of transformations, most of which cannot be dealt with here. Bellugi (1964; cited by McNeill, 1970) reports the progression in the use of certain inflections in two of the children whose linguistic development is described in Figure 10.7. Her findings are shown in Table 10.3.

One of the amusing instances of children's rule learning pertains to the

TABLE 10.3

Development of grammatical usage

	Age (months)	
Type	*Adam*	*Eve*
Present progressive (. . . ing)	*28*	*19.5*
Pluralizing nouns (. . . s)	*33*	*24*
Past tense of regular verbs (. . . ed)	*39*	*24.5*
Possessive nouns (. . . 's)	*39.5*	*25.5*
Third person verbs (. . . s)	*41*	*26*

Source: From Bellugi, 1964.

use of the past tense. English contains certain strong verbs such as *do, go,* and *run,* which are irregular in the past tense. Interestingly enough, these verbs are quite frequent in the vocabularies of children, and the *irregular past tense is used correctly at first.* Children may say went, ran, etc., appropriately. However, once the rule for making a past tense for weak verbs is learned (i.e., add "ed" to the present tense), the rule is overgeneralized to the strong verbs as well, with the result that one hears "I goed to bed," "I falled down," etc. The overgeneralization only occurs *after the transformation rule is learned.* The same thing occurs with irregular plurals. While a child may at first say *teeth,* once the rule for pluralizing is learned, he says *tooths.*

The importance of rule learning rather than imitation learning as the basis for language learning is seen in the extreme difficulty one has when he tries to get a child to give up a rule once he has learned it, or to use it in a more differentiated fashion. The following exchange between mother and child reported by McNeill (1970, p. 1103), which centers around the learning of transformation rules for negation and pluralization of verbs, illustrates the point quite well:

CHILD: "Nobody don't like me."
MOTHER: "No, say 'nobody like*s* me.' "
CHILD: "Nobody don't like me."
(Eight repetitions of the same)
MOTHER: "No, now listen carefully: say *"Nobody likes me."*
CHILD: Oh! Nobody don't like*s* me.

SEMANTIC DEVELOPMENT

Most of the above discussion has focused upon syntactic development, or the development of the structure of language. The development of meanings, however, or semantic development, is also of interest.

In some sense you might argue that semantic development progresses according to the learning of the transformation rules described above, since deep structure is supposed to carry the meaning of language. However, it

appears that children comprehend more than they can say. In other words, they give evidence of understanding what is said to them when, in fact, they cannot express the same meanings themselves. Possibly, then, the problem in learning transformations is to express deep structure in terms of surface structure, rather than vice versa. You might say that the learning of the rules is simply a way of "getting the meanings out."

Eve Clark (1973), a linguist, has studied the development of meanings by examining the ways in which particular words are used. She points out that for the child many meanings are overextended, or overgeneralized. One of this author's children, for example, used the word *moon* to refer to anything that was round in shape and lighter than its background. *Doggie* might be used to refer to any four-legged animal. Apparently, the child overgeneralizes because he responds to only one or two of the many features that specify an object and differentiate it from other objects. What he has to learn is to include more features in his definition, including those that are absent in, say, *doggies*, but present in *cows*. This kind of learning, called concept attainment, will be discussed in more detail in the next chapter.

THEORY OF LANGUAGE DEVELOPMENT

What is the basis for language learning in general, and rule learning in particular? One possibility, mentioned occasionally, is that learning takes place on the basis of imitation. However, this explanation is unlikely, since it is unlikely that a child would ever hear (except in response to his own utterance) a parent say such things as "allgone sticky," as his hands were being washed or "more page," meaning "read some more." Such utterances were quite common in the speech of the child studied by Braine (1963), and other investigators report similar utterances. Rather than mere imitation, psychologists operating in the linguistic tradition (e.g. McNeill, 1970; Slobin, 1971) suggest that the child's language reflects an innate capacity to organize his experience in a meaningful way and express it. The rules, whose operation is seen in the regularity of his grammar, reflect this capacity.

Where do the rules come from? The linguist Chomsky (1965) has suggested a hypothetical, innate *Language Acquisition Device* (LAD), which accepts as input the sounds of adult speech and attempts to determine the rules by which they were produced. The attributes of the various stages of early speech would be understood as simply the product of the LAD at that particular maturational stage. The fact that the rules at this stage of development seem to be the same regardless of language has supported the idea that they reflect the operation of innate processes which are biological characteristics of human beings (e.g., Lenneberg, 1967, 1969; McNeill, 1970; Slobin, 1971). These ideas are not terribly popular in American psychology which, as you should be aware by now, is rather strongly biased toward explanation of such phenomena in terms of learning. Thus you might argue that language has to be learned *from other people*. However, the problem remains to define limits for rule acquisition and application as preprogrammed into the nervous system, and to determine the role that the child's experience with particular speakers plays in establishing, within those bio-

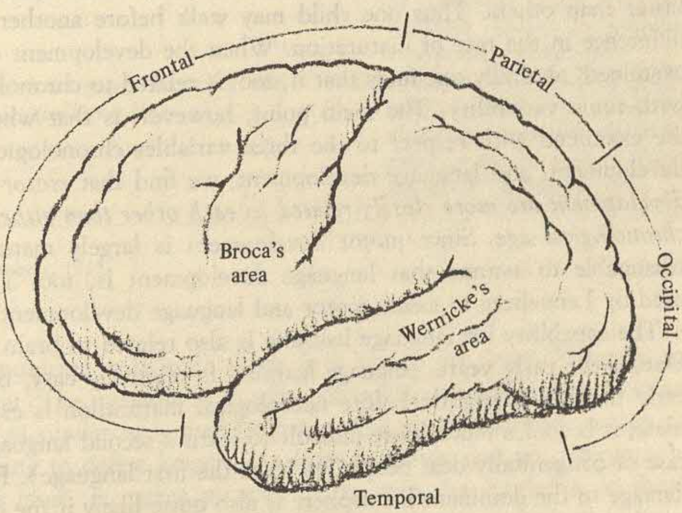
logical limits, the rules that he uses. All that is required is that any theoretical account must jibe with the facts of language.

Biological Aspects of Speech and Language

Speech and language are biological phenomena, just like all other behaviors. They are dependent for their performance upon the anatomical and physiological integrity of the brain as well as other anatomical structures. This assertion, however, is trite indeed unless we can make something out of it in terms of understanding *how* various biological processes are related to psychological phenomena. In the case of speech and language we can take three approaches to the problem: (1) the effects of brain damage in human subjects, (2) the relationship between language development and anatomical and physiological maturation, and (3) the capacity of nonhuman animals for language. Each of these topics will be considered briefly below.

Language and the Brain

In the last century it was discovered that damage to certain areas in the left cerebral hemisphere would produce *aphasia*, which is the inability to speak. The critical region of the brain is known as Broca's area, after the neurologist who discovered it, and seems to be responsible for the motor aspects of speech, i.e., producing the sounds. As you might expect, it includes part of the area supplying the face, shown in Figure 10.8 (refer also to Figure 4.10). Damage to Broca's area produces so-called *motor aphasia*, or the inability to produce speech sounds. A second area is located in the temporal lobe. It is called Wernicke's area, and damage to it results in the inability to comprehend speech, or *sensory aphasia.* Then there is a third area, with



Areas of the brain concerned with language. FIGURE 10.8

no one's name attached to it, located in the junction between the parietal, temporal, and occipital lobes, damage to which seems to interfere with reading.

Penfield's research, in which he stimulated these areas in awake human patients, has already been described (p. 97). You will recall that electrical stimulation interferered with the normal functioning of these areas, in that speech was arrested while the current was turned on. For example, a patient would be naming some objects being shown to him but be unable to continue as long as the current was on. This arrest of speech occurred only when the dominant hemisphere was stimulated.

The dominant hemisphere is usually the left one. Occasionally, in some left-handed people, the dominant hemisphere is on the right side, but this finding is quite unusual. This lateralization of cerebral function is thought to be quite important for language. Human beings are by far the most strongly lateralized species, and there is some indication that individuals with incomplete lateralization may have difficulty reading.

Language and Maturation

It was pointed out in Chapter 3 that the distinction must be made between developmental changes due to maturation and those due to learning. Walking was pointed out as an example of a capability that matures, rather than is learned. While the evidence is not as clear-cut in the case of language ability, there is some indication that the capacity for language is primarily dependent on maturation, rather than specific learning. Eric H. Lenneberg, a psychologist and neurobiologist, has compiled some rather impressive findings in support of this point of view (1967, 1969). For example, he makes this point: Motor development, of course, depends on maturation and would be expected to be related to chronological age, although there would be some variability due to the fact that some individuals mature faster than others. Thus one child may walk before another because of a difference in the rate of maturation. When the development of *language* is examined, naturally one finds that it, too, is related to chronological age but with some variability. The main point, however, is that when individuals are examined with respect to the three variables chronological age, motor development, and language development, we find that *motor and language development are more closely related to each other than either is related to chronological age.* Since motor development is largely maturational, it is reasonable to assume that language development is, too. The milestones used by Lenneberg to assess motor and language development are shown in

The capability for language learning is also related to brain development. During the early years, language learning is relatively easy, but during the early teens, just slightly before neurological maturation is essentially complete, it becomes much more difficult to learn a second language (or, in the case of congenitally deaf people, to learn the first language). Recovery from damage to the dominant hemisphere is also quite likely if the damage occurs early, before age 4. Later damage, after laterality has been established, is much more detrimental, and recovery is less likely (Lenneberg, 1969).

TABLE 10.4

Milestones in motor and language development

Age (years)	Motor Milestones	Language Milestones
0.5	Sits using hands for support: unilateral reaching	Cooing sounds change to babbling by introduction of consonantal sounds
1	Stands; walks when held by one hand	Syllabic reduplication; signs of understanding some words; applies some sounds regularly to signify persons or objects, i.e., the first words
1.5	Prehension and release fully developed; gait propulsive; creeps downstairs backward	Repertoire of 3 to 50 words not joined in phrases; trains of sounds and intonation patterns resembling discourse; good progress in understanding
2	Runs (with falls); walks stairs with one foot forward only	More than 50 words; two-word phrases most common; more interest in verbal communication; no more babbling
2.5	Jumps with both feet; stands on one foot for 1 second; builds tower of six cubes	Every day new words; utterances of three and more words; seems to understand almost everything said to him; still many grammatical deviations
3	Tiptoes 3 yards (2.7 meters); walks stairs with alternating feet; jumps 0.9 meter	Vocabulary of about 1000 words; about 80 percent intelligibility; grammar of utterances close approximation to colloquial adult; syntactic mistakes fewer in variety; systematic; predictable
4.5	Jumps over rope; hops on one foot; walks on line	Language well established; grammatical anomalies restricted either to unusual constructions or to the more literate aspects of discourse

Source: From Lenneberg, 1969.

Language in Animals

Animals communicate with each other in a variety of ways. There is no question of that. The question is to what extent can animal communication be considered as similar to human language. The answer depends partly on how one is going to define language in human beings, and not everyone is agreed on this issue. It makes no sense to go into the subtleties of these arguments here, nor would it be productive to investigate the rather large body of knowledge that has been developed in comparative psychology and

biology concerning how animals communicate with each other. Rather, we shall emphasize that human language is a highly complex, abstract, and flexible means of communication in which an infinite variety of contents can be expressed. With this admittedly biased frame of reference we shall briefly examine various attempts to teach another animal—the chimpanzee is the only primate that has been seriously studied—to communicate by using something resembling human language.

HOME-RAISED CHIMPS

Suppose that a chimpanzee, which is generally recognized to be a highly intelligent, highly sociable animal, were raised in a human home with all the loving care, stimulation, and social interaction received by a human child. Would such an animal learn to speak? W. N. and L. A. Kellogg (1933) raised a chimpanzee named Gua in their home along with their own son, Donald. While Gua's motor development soon far outstripped Donald's (she could swing by her hands, etc.), there was no comparison with Donald's conceptual and language development. Gua did not learn language.

Later, two other psychologists, Keith and Catherine Hayes (Hayes & Nissen, 1971) raised Vicki, a chimpanzee, in their home for over 6 years, again trying to give her all the advantages accruing to a human child. The only words they were able to teach Vicki to say were *Mama*, *Papa*, *cup*, and *up*. Even these words were not used in any way resembling human language.

SIGN LANGUAGE

One possibility may be that chimpanzees cannot be taught to speak because they lack the motor apparatus for producing human sounds. Perhaps, if some other means of communication were used, they would be able to demonstrate language capability. Two investigators, R. A. and Beatrice T. Gardner, have explored this possibility with a female chimpanzee named Washoe. Their procedure has been to teach Washoe the American Sign Language, and to avoid any other form of verbal communication with her. By 1971, after 5 years of training. Washoe had learned and used more than 80 signs (Gardner & Gardner, 1971). These signs, according to the Gardners, are used spontaneously and appropriately, and, occasionally, in combinations different from those used by the trainer. This research is still in progress, and several other chimpanzees are being taught sign language.

PLASTIC WORDS

A different approach has been taken by David Premack (1971). Rather than sign language, he has attempted to teach Sarah, a female chimpanzee, to "speak" by placing symbols representing various concepts in appropriate orders on a magnetized board. She was taught the symbols for objects such as apple, banana, Sarah (her name was represented by a symbol), the names of her trainers, etc., as well as symbols for several verbs, adjectives, prepositions, the conjunction *if/then*, and the particles *yes* and *no*. She has learned relationships such as *X* (a symbol) is the name of *A* (a concrete object), and has used conditional statements appropriately such as "If Mary takes red (i.e., chooses a red color), then Sarah takes an apple."

Have Washoe and Sarah acquired the rudiments of language? The Gardners and Premack think so. Some other investigators think not. It gets

A Computer-Controlled Environment for Language Training

One of the aims of scientific study is to gain control over the phenomena of interest. In the case of language and its development the problem is rather large, in that it is quite difficult to control the environments of human children to the extent necessary to understand the phenomenon. It would be very helpful if language capacity could be demonstrated in some lower organism whose developmental history could be controlled. The chimpanzee is an obvious candidate, as the studies described in the text indicate.

To carry the matter further, however, D. M. Rumbaugh of Georgia State University and his colleagues at the Yerkes Regional Primate Center have constructed a computer-controlled environment, operative 24 hours per day, in which a 3-year-old female chimpanzee, Lana, has been placed for language training. The language (called Yerkish) is represented by nine design elements, or forms, plus three background colors that can be combined in various ways to form lexigrams which vary in color and form. The lexigrams correspond to words in English. However, in contrast with English, which contains many ambiguities, Yerkish is unambiguous. A given lexigram corresponds to one and only one English word. Also, ambiguities arising from different word orders within English sentences are eliminated by requiring, for example, that lexigrams corresponidng to actors (i.e., subjects of sentences) be produced before those corresponding to actions (i.e. verbs), and the permissible subject-verb-object relationships are further reduced by permitting only certain combinations. For example, "Lana eats juice" would be incorrect, since juice is not one of the objects that, according to Yerkish grammar, can be eaten, M & M's, on the other hand, can be eaten, and so "Lana eats M & M's" would be gramatically correct.

At this point the equipment permits the use of 125 lexigrams, which are displayed on illustrated panels (as shown in the figure). Sentences may be made either by Lana or by the experimenter and are displayed on the upper panel. Each sentence requesting something must begin with "Please" and end with a period. Lana may press buttons corresponding to the lexigrams to make sentences such as "Please machine give juice," or "Please Tim tickle Lana." Many of the rewards referred to by "Please"-type sentences are automatically dispensed, such as viewing a segment of a film on primate behavior, or opening a shade to permit seeing outside, or having music played (Lana seems to prefer rock 'n' roll) and can therefore be administered 24 hours a day.

Incorrect sentences result in no reward and may be erased by pushing the period key. Lana seems to understand this, because she will push the period key to correct ungrammatical sentences whether they are mistakenly generated by her or by the experimenter (Rumbaugh, Gill, & von Glasersfeld,

Courtesy D. M. Rumbaugh.

1973). She will also complete sentences partially generated by the experimenter and will usually do so by using only correct lexigrams (i.e., correct given the constraints imposed by the partial sentence generated by the experimenter). For instance, she will erase partial incorrect sentences such as "Please give machine," and will complete sentences such as "Please machine give."

The authors conclude

Lana accurately perceives Yerkish words, reads their serial order, and discriminates whether they can or cannot be completed in order to obtain

the various incentives. And if successful completion of the valid sentence starts is viewed as analogous to typewriting, it can be said that Lana both reads *and* writes *(p. 733).*

Another aspect of her language behavior is the naming of objects, also demonstrated by Premack and the Gardners. Lana, when given the question "? What name of this" in lexigram form would in many instances push the correct symbol for the object being displayed to her.

It would appear that this project, perhaps more efficiently than previous projects, has the capability of demonstrating in an unequivocal way whether or not chimpanzees have language capacity, i.e., the ability to generate new sentences from the linguistic components, and to communicate using the language. Furthermore, it can also evaluate in a rather well-controlled situation the conditions under which whatever capability they have can be developed.

down to the question of what one means by *language.* It is possible to define language in other ways so that other species have it. At this point there is no generally agreed-upon theory of language that defines it in a way which would allow us to answer the question. It is certainly true that human children, even retarded ones, learn language very easily and naturally, whereas a monumental effort is required in the case of the chimpanzee. There are even anecdotal reports (e.g. Jesperson, 1947) of children raised in isolated conditions by deaf parents such that they were not exposed to their "native" language, who developed idiosyncratic languages of their own which they used to communicate with one another. On the other hand, perhaps chimpanzees would speak more readily if they were more highly motivated to do so. The whole social situation surrounding children's interaction with parents and with other children would presumably be highly reinforcing of language development. Perhaps later studies will shed some light on these questions. (See p. 295.)

Summary

Language consists of the ability to communicate, through speech and writing, in a symbolic and flexible way. A major problem in psychology is to explain the capacity to generate and comprehend an infinite number of sentences. Speech is a carrier of language, and consists of combinations of phonemes, which are distinguished on the basis of where they are produced in the vocal cavity.

The development of speech involves gaining control over the vocal apparatus; during the first year the progress is from back to front for consonants,

from front to back for vowels. The first word, a front consonant and a back vowel (e.g., *Mama*) is uttered at about 12 months. Later developmental stages include gaining further control over the apparatus, and learning correct and incorrect combinations of sounds.

Speech perception is an active process, involving segmentation of the sounds into meaningful units: words. There are several different theories as to how speech sounds are recognized, including template matching, feature extraction, the motor theory, and analysis by synthesis. Each has its advantages and disadvantages.

One problem in the study of language is how we are able to recognize and generate grammatical sentences. Grammar may be understood in terms of the learning of correct word order, or as the learning of a set of rules. One approach—transformational grammar—emphasizes the learning of rules for changing simple declarative sentences to various voices, tenses, and modes. The distinction is made between surface structure of sentences, which is the form in which they are communicated, and the deep structure, which is the simple active declarative sentence that was changed through the transformations to a particular surface structure. Meaning and memory are considered to be represented by the deep structure.

Semantics, or the study of meaning, is another aspect of language. Meaning has been understood in terms of imagery, patterns of associations, sets of semantic features, and as nonverbal conditioned responses evoked by words. It has been measured by means of word association tests as well as the Semantic Differential, whereby concepts are rated on a set of bipolar adjectival dimensions relating to the three major dimensions good-bad, strong-weak, and active-passive.

Language development begins in the second year of life with holophrastic speech, in which single words carry the meaning of whole phrases. Two-word utterances, or telegraphic speech, follow. Two-word sentences are grammatically orderly and are produced according to certain rules. The learning of transformation rules is a long process, in which the rule, once learned, is overgeneralized at first, resulting in sentences such as "He goed to town." The relative importance of learning as opposed to innate capacities in language development is a controversial issue, with some theorists viewing language as a species characteristic whose form is determined by the inherent structure of the brain, while others view it as primarily a learned phenomenon.

Language depends on the integrity of certain areas in the brain, usually located on the left side. Damage to these areas produces *aphasia*, or the inability to recognize or use language. Development is highly correlated with other signs of physiological maturation such as walking.

Attempts to teach language to chimpanzees have met with mixed success. Three approaches appear promising at the moment. One of them involves the use of sign language, one employs objects as symbols for words, and the third uses a computer-controlled environment. In all of these approaches the problems due to inherent limitation in the speech generating processes are bypassed. This work is still in progress.

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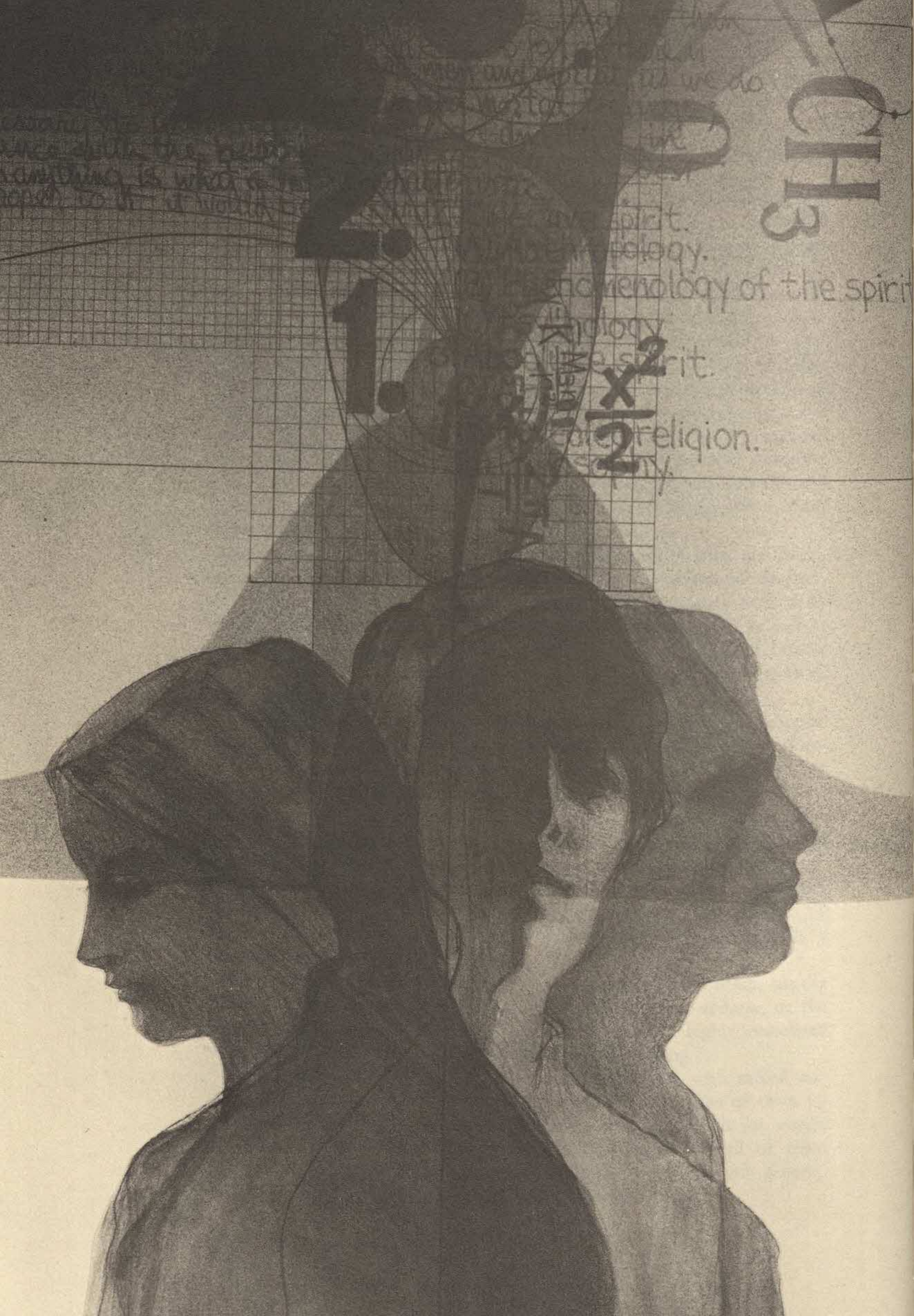

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Thinking

11

Thinking is activity that stands for something else. Consider the following sentences:

I think I'll go to town.
What do you think about the ecology movement?
Think of a four-letter word that starts with "b" and is a synonym for *vessel.*
I'm thinking of a number between one and ten.

The verb "think" is used to refer to something inside that stands for something outside. It has other meanings, too, as you will see presently, but the prime characteristic of thinking to be discussed in this chapter is that it is *representational activity.* In this respect it is quite closely associated with language, which also involves representational activity. Indeed, some students of thinking and language consider the two processes to be inseparable. This point will also be discussed later.

Thinking is obviously a very important kind of human activity, being responsible for factories, slums, television sets, paintings, symphonies, wars, democracies, dictatorships, laws, bank robberies, and courses in psychology. In other words, it is possible (although not necessarily correct) to regard almost all human behavior and its products as being due in some way to thinking. Whether or not thinking is really so all-pervasive, it is certainly a problem of monumental importance for psychologists, who must come to some understanding of the nature of thought processes and how they affect behavior. As you have probably come to expect by now, psychologists do not yet have any complete answers to the questions pertaining to thinking. We are, however, beginning to achieve some understanding of thinking, and the intent behind this chapter is to give you some indication of the directions in which these efforts are proceeding.

First, we shall consider some different ways in which thinking is characterized by psychologists. In other words, what is it? (You have already seen this type of question asked about other constructs such as learning, mean-

ing, memory, etc.) We will also consider the question of thinking in animals, since some characterizations of thinking lead one to the conclusion that some animals can think in some ways. Next, we shall consider several different types of thinking, involving the learning of concepts, solving problems, thinking logically, and thinking creatively. Some recent work in the physiology of thinking will also be discussed. Finally, we shall take up the matter of development of thinking. Here the focus will be primarily on the work of Piaget, whose developmental studies and theorizing have been most influential, although we shall also consider briefly the development of creativity.

Characterizations of Thinking

One of the first problems in understanding anything is to come to some, at least temporary, conclusion as to what it is like, or what elements it is composed of. In the psychological study of thinking, the problem has been to relate thinking to other psychological processes and to try to come to some agreement as to its elements. While we can in no way say that agreement has been achieved, we can spell out some of the ways in which psychologists have characterized thinking. In this section we shall examine thinking as *implicit behavior*, as the *internal manipulation of symbols*, including images and verbal symbols, and as the *extension of evidence*. We shall also consider whether, given these characterizations of thought, animals may be considered to think.

Thinking as Implicit Behavior

The founder of behaviorism, John B. Watson, wanted to do away with mentalistic concepts in psychology. As you might think, this would be a hard goal to achieve in a field in which thinking was one of the subject matters. Nevertheless, Watson, in order to handle the concept of thought, suggested that thought was actually *implicit* behavior (1930). That is, thinking involved covert movements of muscles. For example, thinking with words was thought to involve covert movements of the muscles of the mouth and larynx.

What is the evidence that muscles are involved in thought? A number of years ago Jacobson (1932) recorded the electrical activity of muscles while subjects were instructed to think but not to move. He found that a subject would, for example, show electrical activity in his right arm if he were instructed to think of hammering a nail, even though his arm did not move. When instructed to imagine talking, activity in the lips and tongue would be recorded. More recently, Locke and Fehr (1972) report that subjects made covert movements of the lips when rehearsing words containing labial phonemes (e.g., /b/, /p/). This covert vocalization occurred (1) when they saw the words and knew they were going to have to *say* them later, and (2) when they heard the words and knew they were going to have to write them later. In other words, covert vocalization seems to be an integral

part of certain kinds of information processing and is quite readily observed while subjects are thinking.

There are, of course, different ways to interpret these findings. It is one thing to show that thought has muscular consequences, and quite another to say that thought *is* these muscle movements. Actually, no one seriously considers the latter alternative nowadays. The question of what role these muscle movements actually play in thought, however, is quite timely. Recall from the last chapter that one seriously considered theory of speech perception is the motor theory, which says that speech is recognized by implicitly producing it. Later on you will see that motor processes are considered to be quite important in the development of thinking, and we shall probably see in the next several years an increasing interest in their role in thinking and other cognitive activity.

Thinking as the Manipulation of Symbols

You learned in the previous chapter that the meaning of a word could be thought of as the imagery which it evoked or the verbal associations which were produced. These same symbolic, or mediational, processes are also applicable to thinking. Consider the various internal processes that *represent* external events. Thinking about these events involves the manipulation of these representational processes. For example, the problem described in the previous chapter in which the children were asked to place a truck so that it was pulling or being pulled by another truck could just as well be viewed as a problem in thinking. The child was given a problem and had to think of the answer. In the process of obtaining the answer, he manipulated the internal representations, or, in this case, the images of the objects of concern, and decided where to place the truck he was holding in his hand.

The question of the role of images and verbal language in thinking has a long history. At the University of Würzburg a psychologist named Külpe and his associates used the method of introspection to try to develop an understanding of the elements involved in thinking. In many experiments they would give their subjects simple tasks to perform, such as judging which of two weights was heavier or thinking of a specimen of a given category such as "bird." Subjects would be given the question and asked to report the things of which they were aware when solving the problem. They would usually be aware of all the elements of the problem, as well as the answer. However, there was no awareness of the process whereby the answer came. It just appeared. In other words, they could discover no conscious content that corresponded to thinking of the answer to the problem. For this reason the "school" of psychology that developed around the work of these people was called "imageless thought," since thought seemed not to involve images or any other conscious content (Boring, 1950).

Whether the stage immediately preceding the answer to the problem is represented in consciousness or not, it is clear that mediational processes such as imagery and verbal processes are quite important in most thinking, if only because of their importance in memory (see Chapter 8) and because they constitute much of the meaning of the words with which a problem

may be stated and the answer given. Furthermore, as you will see later, the way in which the problem is represented is often quite important in its solution, and some solutions require reorganizing the elements of the problem, or "seeing things in a new light."

Thus, in general, language must play a very important role in thinking. Being able to represent the elements of a problem in an abstract way makes it easier to apply general solutions to specific problems, and permits the generalization of thinking skills across many situations. However, whether thinking in some way is identical with internal language is another matter, and we have no good answers to that question yet.

Thinking as Extension of Evidence

The late Sir Frederic Bartlett (1886–1969) had this to say about thinking:

> The broad objectives of thinking remain very nearly the same, in whatever field the thinker operates, and with whatever kind of evidence he is concerned. Always he must try to use the information that is available to him so as to reach a terminus, based upon that information, but not identical with it, and he must so set out, or be prepared to try to set out, the stages through which he passes, that he can reasonably hope that where, for the time being, he comes to rest, everybody else who is not mentally defective, or mentally ill, or abnormally prejudiced, must come to rest also (Bartlett, 1958, p. 97).

This characterization of thinking focuses upon what the thinker does, i.e., his accomplishments, more than upon the nature of the "mental elements" that comprise thought. He would give his subjects problems such as those shown on p. 305, in which they would have to take what evidence was given them and rearrange it in some way or else take the evidence and extrapolate it to come to a conclusion. While Bartlett clearly recognized the importance of symbolic reference in thinking, particularly where one must extrapolate from a given to a future situation, his focus was upon its overt characteristics as verbalized by subjects while solving problems.

Do Animals Think?

Investigators of thinking in animals have focused upon the idea that thinking involves symbolic reference to situations not immediately present. In other words, animals must show that they can represent evidence not present in the immediate stimulus situation and use it in solving a problem. Three problems presumably involving this capacity are now described.

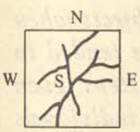
THE TEMPORAL MAZE

The temporal maze, discussed previously in Chapter 7, is shown again in Figure 11.1(a). It is different from the usual spatial maze in that the only

Think about These Problems

1. *Donald*
Gerald
Robert

Given the above arithmetic-like expression, and the additional information that D=*5, find out which letters and which numbers go together. Make a note of the steps you take in coming up with a solution. Then give the prob-*



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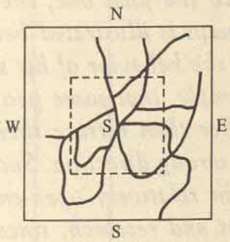

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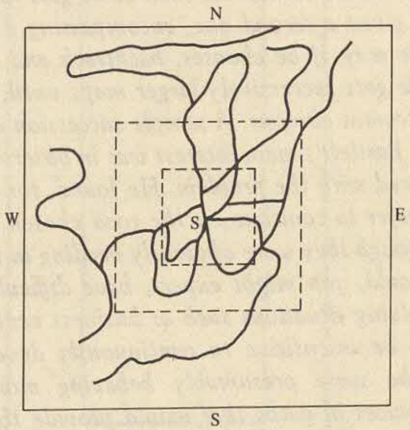

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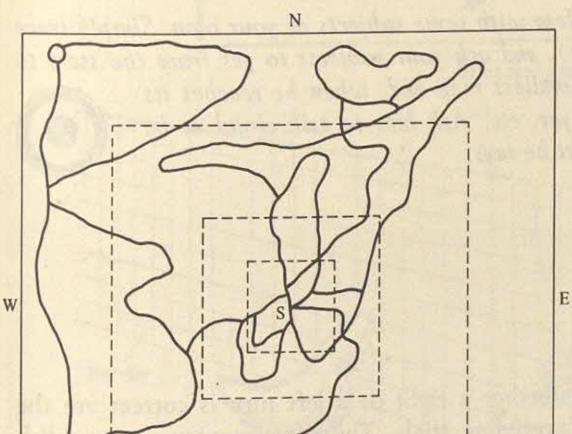


No. IV

F. C. Bartlett, Thinking: An Experimental and Social Study. *London: George Allen and Unwin, 1958.*

lem to several other people to solve, and ask them to tell you what they are doing at each step. Make a note of what is happening. Can you distinguish any regularities in the way the different subjects solved the problem? Read what Bartlett (1958, pp. 51–63) has to say about the way his subjects solved the problem.

2. Thinking is often directed toward some end, and the path to the end may be quite circuitous, in the sense that what appears to be the appropriate direction may, on later evidence, turn out to be a blind alley or a much too roundabout route. Bartlett (1958) has simulated this situation in a series of "map-reading" problems. The subject is shown a section of a map, and then instructed to take some road that will get him, say, to a destination in the northwest corner. As soon as he gets to the end of the road on that map, he is given a second one, encompassing a somewhat wider area than the first. He may, if he chooses, backtrack and take another road or he may go on. He gets successively larger maps until, with the final one, the correct path becomes obvious. A sample succession of maps is illustrated below.

Bartlett's main interest was in observing the behavior of his subjects when faced with the problem. He found, for example, that some people tended to prefer to continue on the road chosen rather than retrace their steps, even though they were obviously heading in the wrong direction. Such individuals would, you might expect, have difficulty in relatively open-ended problem solving situations such as business ventures and research, since they appear to be insensitive to continuously developing evidence. Other individuals, who were presumably behaving more appropriately, seemed to prefer choices in paths that would provide them with a greater number of subsequent choices later.

You might try this problem with some subjects of your own. Simply trace the maps (or cut them out), and ask your subjects to get from the start to the goal. Begin with the smallest map and, when he reaches its boundary, add the next layer, etc. Ask him to talk aloud as he goes, and make note of what he says.

cues available to indicate whether a right or a left turn is correct are the turns that were taken on preceding trials. The experimenter can establish ahead of time a certain *pattern* of correct choices such as single alternation, RLRLRLRL; double alternation, RRLLRRLL, or any other pattern. Solution of the problem involves the ability to conceptualize the pattern and remember the responses that were made previously. The usual pattern studied is double alternation, which rats are unable to learn (Hunter, 1928). Raccoons can go one double alternation sequence, RRLL, before going over

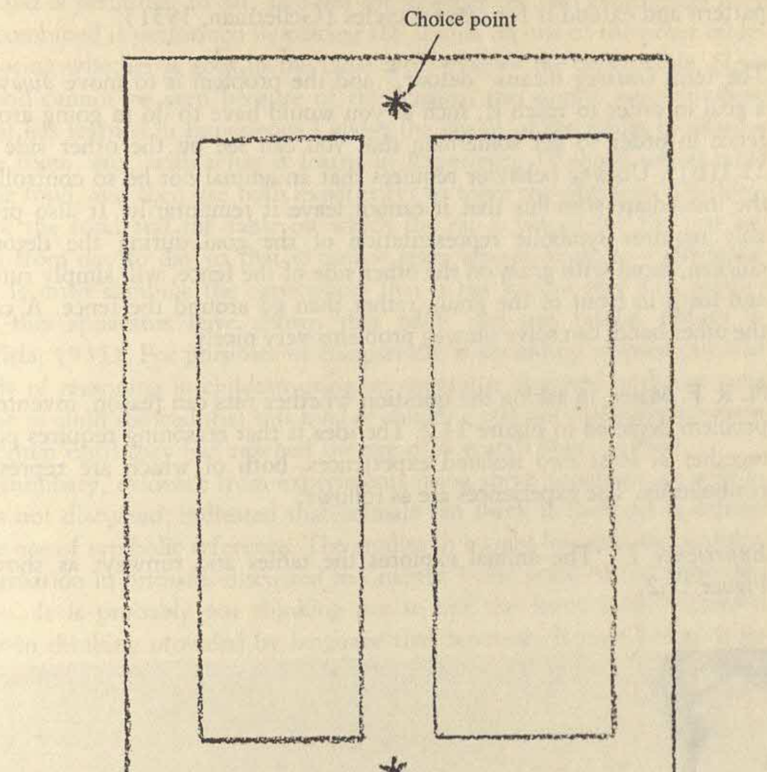


FIGURE 11.1 *Two experimental situations for studying thinking in animals: (a) the temporal maze; (b) the umweg situation.*

into a position habit (i.e., all L's or all R's), while monkeys can learn the pattern and extend it for several cycles (Gellerman, 1931).

UMWEG LEARNING

The term *Umweg* means "detour," and the problem is to move *away from* a goal in order to reach it, such as you would have to do in going around a fence in order to get something that you can see on the other side [Fig. 11.1(b)]. Umweg behavior requires that an animal not be so controlled by the immediate stimulus that it cannot leave it temporarily. It also presumably requires symbolic representation of the goal during the detour. A chicken, faced with grain on the other side of the fence, will simply run back and forth in front of the grain, rather than go around the fence. A cat, on the other hand, can solve umweg problems very nicely.

THREE-TABLE REASONING PROBLEM

N. R. F. Maier, in asking the question whether rats can reason, invented the problem depicted in Figure 11.2. The idea is that reasoning requires putting together at least two isolated experiences, both of which are represented symbolically. The experiences are as follows:

Experience I. The animal explores the tables and runways as shown in Figure 11.2.

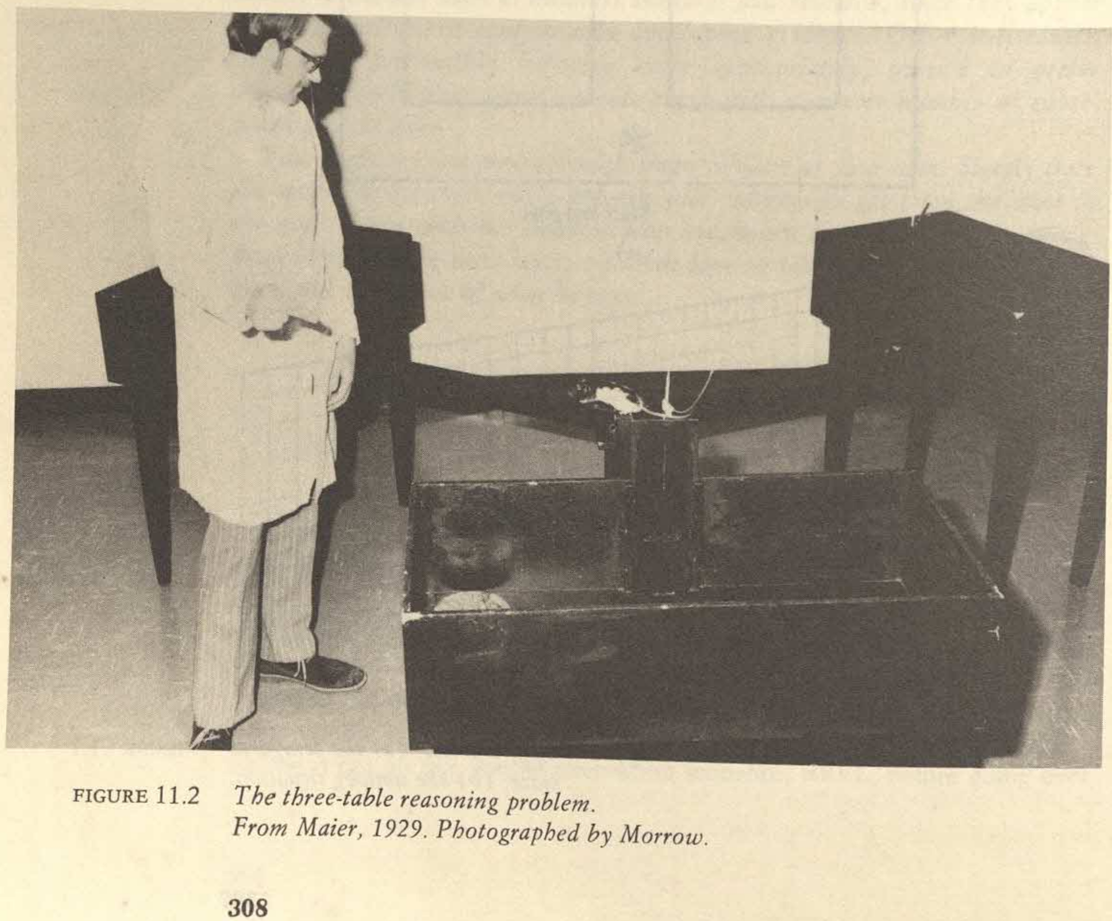


FIGURE 11.2 *The three-table reasoning problem.*
From Maier, 1929. Photographed by Morrow.

Experience II. The animal is placed on one of the tables, which contains food, and is permitted to eat. The test for whether the two experiences have been combined is performed by placing the animal on one of the other tables and noting whether it goes to the table with food or the other table. Since the food cannot be seen because of the screens, the animal must combine what it has learned in Experience I about the layout of the tables in relation to the room, etc., with what it learns in Experience II about which table has the food, and then use both experiences to solve the problem. The location of the food and the table on which the rat is placed for the test are varied from day to day so that it cannot learn always to go to a particular table. It must combine the experiences that it has had *on that day*. Studies using this apparatus have shown that adult rats can reason (Maier & Schneirla, 1935). For purposes of comparison, it should be pointed out that a study of reasoning in children using an apparatus designed with the same scheme in mind showed that this kind of thinking was not markedly apparent in children until they had reached the age of 6 years (Maier, 1936).

In summary, evidence from experiments using these situations, as well as others not discussed, indicated that animals can think if thinking is defined by the use of symbolic reference. The studies in insight learning and learning set formation in primates discussed in Chapter 7 also point to the same conclusion. It is probably not thinking per se but the fantastically increased *power* in thinking provided by language that separates human beings from other animals.

Types of Thinking

In the previous section you saw that thinking could be conceived of in several different ways. Another way to subdivide the field is in terms of different types of thinking. We shall consider four different types: *concept formation, problem solving, logical thinking* (or syllogistic reasoning), and *creative thinking.*

Concept Formation

Of all the areas of thinking, concept formation has received the most attention in psychological experimentation. One of the reasons for this fact is that the process can be approached quite objectively, in the same way that other kinds of learning can be studied. Furthermore, it is quite important, since much of thinking is done with concepts.

A concept expresses a relationship between events. It groups events that are similar in some respects and different in others, often (but not always) on the basis of similarity. The concept "tree," for example, refers to a class of plants that are living, woody, and of a certain size. The difference between "tree" and "bush" or "shrub" is primarily in terms of size. Acquisition of the concept requires that certain essential features or attributes be *abstracted*, or separated out, from a number of concrete events. These features must then be *generalized* to other events.

In addition to abstracting the relevant attributes, one must also learn the *logical rule* which relates the relevant attributes to the concept. For example, the *conjunctive* rule specifies that an event must have several different properties in order to be an instance of a concept. Thus, in order to be an instance of the concept "helmet," an object must not only be "covering for the head," but also "hard." The *disjunctive* rule, on the other hand, specifies that *any* object having a particular attribute is an instance of the concept. A "musical instrument" may, for example, be any of the following objects (and more): guitar, oboe, violin, piano, tympani, piccolo, kazoo, and comb and paper. Other logical rules are shown in Table 11.1.

The Learning of Concepts

Concept learning is, of course, very much a part of the process of language learning, discussed in the previous chapter. We shall consider some additional aspects of this process in children when we take up the development of thinking later on in this chapter. At the moment we shall examine some of the ways in which concept learning has been studied in adult subjects.

Learning a concept may be divided into two processes: (1) learning the rule, and (2) learning the attributes of the relevant stimuli to which the rule applies. The rules, listed in Table 11.1, may be applied, of course, to many different materials. The conjunctive rule used to define "helmet" applies to objects with certain attributes including shape, size, and other physical attributes. In the laboratory, attributes are usually rather easy to identify. For example, a task may involve learning that a correct playing card is "all spades," (i.e., the relevant attribute is shape), or "all fours" (the relevant attribute is number), or "the four of spades" (the relevant attribute being both shape and number), etc. These processes were separated out in a series of experiments by Haygood and Bourne (1965). In one experiment they either told the subjects what the rule was (from among those listed in Table 11.1) but required the subjects to learn the attribute; or they told them what the attribute was, in which case they had to learn the rule; in a third condition they had to learn both the rule and the attribute. They found that rule learning was easier than attribute learning, and,

TABLE 11.1 *Rules applicable to the learning of concepts with two possible relevant attributes, color and shape*

Rule	*Description (example)*
Affirmation	*All red items*
Conjunction	*All that are both red and square*
Inclusive disjunction	*All items that are red or square or both*
Conditional	*If the item is red, then is must be square*
Biconditional	*Red items, but only if they are square*

Source: From Haygood & Bourne, 1965.

as you might expect, having to learn both rule and attribute was the most difficult of all (see Figure 11.3).

Certain rules are easier to learn than others. As you can see in Figure 11.3, conjunctive concepts are the easiest to learn, while the conditional rule is the most difficult.

Experiments by other investigators have focused upon the characteristics of attributes that promote easy learning. When the relevant attribute is *emphasized* in some way, a concept based on it will be learned more readily than if the subject has to deal with a number of equally salient attributes. Also, if a concept contains a number of relevant attributes, it will be identified more easily than if there is only one such attribute. For example, if the concept is "small blue squares" and the stimulus set is arranged so that all squares are also small and blue, and all blue objects are also small squares, and all small objects are blue squares, the concept will be easier to attain than if only one of the attributes small, blue, and square is relevant.

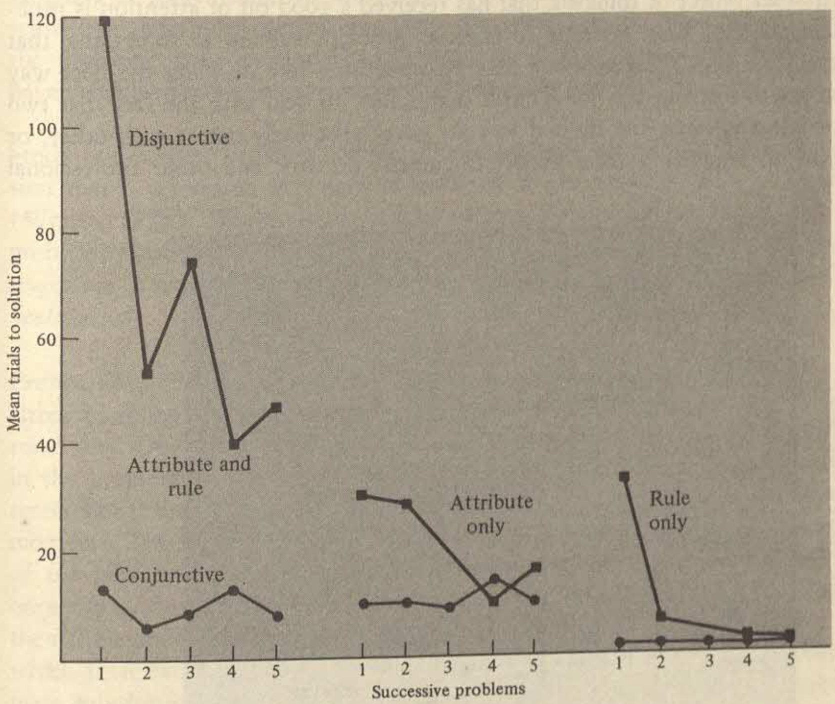


FIGURE 11.3

Attribute and rule learning. The number of trials required to attain the solution are shown when the subjects had to learn both the attribute and the rule (left panel), when they had to learn the attribute only (center panel), and when they had to learn the rule only (right panel). The learning curves for two different rules are shown, although other rules were also used in the experiment. Note that learning the attribute and the rule was the hardest, followed by the other two conditions. Also, note that the disjunctive rule was more difficult to learn than the conjunctive rule.

From Haygood & Bourne, 1965.

The more irrelevant dimensions, however, the more difficult will be the concept, because the subject has to learn to ignore the irrelevant dimensions. The results of an experiment in which the number of relevant and irrelevant dimensions in a concept were varied are shown in Figure 11.4 (Bourne, 1966).

An interesting finding in some studies of concept learning is that subjects may be able to learn a difficult concept, in the sense that they can select stimuli which are correct examples of the concept, but be unable to verbalize the basis for their selection. An early experiment by Hull (1920) employed Chinese characters in which the "concept" was defined by the presence of a particular radical in otherwise different characters. Many of Hull's subjects were able to learn the concepts but were unable to say why. The implications of this finding seem rather far reaching, in that it suggests that a significant portion of the meaning of some concepts we use may be unconscious.

Problem Solving

Another aspect of thinking that has received a good bit of attention is problem solving. Like concept formation, problem solving is something that everyone does. The problem may be something like deciding the best way to get to town in the five o'clock traffic, how to deal with the fact that two people you have just invited to your party absolutely detest each other, or how to organize a term paper. Engineers, doctors, and other professional

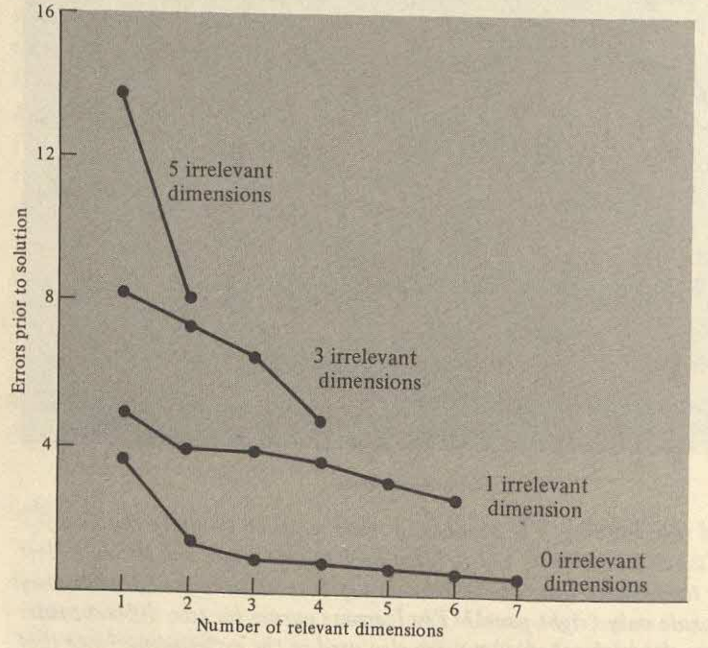


FIGURE 11.4 *Errors in concept learning for different numbers of relevant and irrelevant dimensions. Note that the learning is easier when there are more relevant dimensions and is more difficult when there are more irrelevant dimensions. From Bourne, 1966.*

people, of course, solve problems of a highly technical nature every day. An architect, for instance, may be faced with the problem of designing a building that is (1) economical, (2) functional, and (3) aesthetically pleasing. A doctor is faced every day with the problem of diagnosis and treatment of diseases based upon overt symptoms. In each case there is a *goal* that must be achieved, and there is a certain amount of knowledge, or evidence, that bears upon the problem. The problem is to arrange the evidence in such a way that the goal is achieved, or at least that a pathway to the solution becomes apparent.

Problem solving has been studied in basically two ways. One approach is to identify people who are good at solving problems and, through interview or observation, try to find out how they do it. The other approach is to develop a set of standard problems, which are presented to subjects in a laboratory situation, and study the ways in which they are solved. While the second approach permits a higher degree of control and also a wider sampling of individuals, the first approach is perhaps more realistic, in the sense that individuals performing their life work may be expected to take the problems they encounter more seriously. Both approaches, however, have yielded valuable information about thought processes.

STAGES IN PROBLEM SOLVING

Studies of creative problem solving in professionals have led to the conclusion that a succession of stages is involved in the solution of a problem (Wallas, 1926). While all the stages are not equally prominent in every problem, some aspect of each seems to be present in most problems. The stages are given the names *preparation, incubation, illumination,* and *verification.*

Preparation. Thinking was considered above as extension of evidence, either by filling in a gap, extrapolation of the evidence, or rearranging it in some way. Obviously, the evidence must be assembled, and this takes place in the preparation stage. The process may take years, as in the case of a researcher trying to discover the cause of cancer, or it may take only a few moments. The stage also involves a more basic component—the *statement of the problem.* Sometimes the problem is more or less implicitly stated once the evidence is assembled; sometimes the problem is stated first, and then the evidence sought; sometimes a bit of evidence suggests a problem, which then demands getting more evidence. More often than not, the ultimate solution of the problem depends very much on the way the problem is stated and the way the evidence is arranged. This is one of the points at which creativity (see below) makes its major contribution. A creative problem-solver is good at rearranging evidence and restating problems. This is also a point at which language is important, since language permits the statement of the problem in abstract terms.

Incubation. Sometimes the problem "solves itself" once it is stated in the right way. Sometimes one is not so lucky, and no solution immediately suggests itself. When the solution is not forthcoming, many problem-solvers

report that a period of inactivity, during which the problem is dropped and other activities taken up, is quite helpful. This stage is called *incubation* because, although there is no active attempt to solve the problem, something seems to be happening at an unconscious level that may eventually bring about a solution.

Illumination. After the period of incubation, which may last for minutes or years, depending on the problem, the answer may come in a flash of insight. The light bulb depicting this stage in comic strips is quite appropriate. It is sometimes called the "Aha phenomenon," and is presumably what occurred when Archimedes, upon discovering how to determine the amount of gold in the king's crown, jumped out of the tub in which he was bathing and, so the story goes, cried "Eureka, I have it!" The basic idea is that the answer comes suddenly, when one is not expecting it, and often carries with it an emotional feeling.

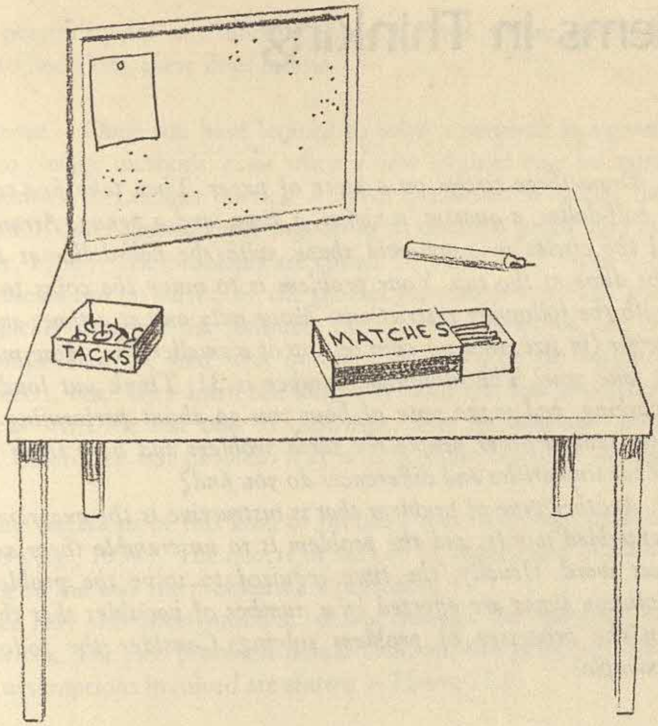
Illumination may come when one is in a drowsy state. The famous chemist Kekulé had been wrestling with the problem of the structure of certain organic compounds such as benzene and other aromatics. While dozing on a bus, he dreamed of carbon atoms dancing, and suddenly they joined hands and formed themselves in a ring. He awoke, knowing that he had solved the problem: Benzene is constructed of a ring of carbon atoms.

Verification. Unfortunately, the Aha phenomenon does not come with a guarantee as to its validity. No one has kept records as to the ratio of invalid to valid Ahas, but there are enough invalid ones to suggest that any solution that comes in illumination needs to be checked in a more direct, explicit way against the statement of the problem and all the evidence that is applicable. If the solution does not check out, then the problem still exists, and may have to be reincubated, so to speak. On the other hand, illumination may give the main outlines of a solution that has to be worked out in more explicit detail during this stage. In either case, the Aha must not be taken for granted.

FACTORS AFFECTING THE EASE OF PROBLEM SOLVING

Laboratory studies of problem solving have given some insights into factors that influence the ease with which problems can be solved. The common denominator of most of these studies is that the *set* of the subject is crucial because it affects what is going to happen during the preparation stage. Set, it turns out, may be affected by (1) the way the elements of the problem are presented, (2) past history in solving problems of a particular sort, and (3) personal factors that determine the flexibility with which one can alter his set and/or rearrange the elements of the problem statement. The first two factors will be discussed in the following sections. The third factor will be discussed in a later section on creativity.

Manner of Presentation. This factor is best illustrated by means of an experiment. Assemble the following items, which are depicted in Figure 11.5: a box of matches, a candle, a small bulletin board, and a box of



The experimental situation as seen by a subject in a problem-solving experiment like that conducted by Duncker (1945). The problem is to mount the candle, lighted, on the bulletin board. FIGURE 11.5

thumb tacks. Your task is to devise a method for mounting the candle onto the bulletin board and lighting it in a way that is safe, i.e., so that it will not scorch the bulletin board. You may use only the items listed above. (Think about how to solve this problem before reading on.)

The best solution, and the one that is usually advanced by students, is to take the match box, tack it to the bulletin board, mount the candle on the box by melting some wax and sticking the candle in the wax, and relight the candle. Most people eventually solve the problem. The point is, however, that the way the items are presented at first has an effect on how long it takes to solve it. When the matches are *in* the match box, as in Figure 11.5, the solution requires longer than when they have been previously dumped out of the match box. Karl Duncker (1945), who experimented with this problem as well as a number of others, thought that the difference was caused by the effect on the subjects' ability to see the matchbox as having some function other than that of holding matches. In other words, the problem was in some sense a perceptual one. The subject, in order to solve it, had to "see" the matchbox as having an unusual function, and this perceptual rearrangement is easier if the matches are outside, rather than inside, the box. Duncker suggested the term "functional fixedness" to refer to the tendency to stick with the ordinary functions of objects, rather than

More Problems in Thinking

1. Draw three circles on a piece of paper. Then take five coins as follows: a half-dollar, a quarter, a nickel, a dime, and a penny. Arrange them in one of the circles in a pyramid shape, with the half-dollar at the bottom and the dime at the top. Your problem is to move the coins to the next circle with the following restrictions: Move only one at a time, and never place a larger (in size, that is) coin on top of a smaller one. How many moves does it take you? The minimum number is 31. Think out loud while you are working, and make note of how you go about performing the task. Then give several other people the same problem and have them think out loud. What similarities and differences do you find?

2. Another type of problem that is instructive is the anagram. Anagrams are scrambled words, and the problem is to unscramble them and find the correct word. Usually, the time required to solve the problem is recorded. Solution times are affected by a number of variables that throw some light on the processes of problem solving. Consider the following lists, for example.

1	*2*	*3*
yenoj	*lnnie*	*emnlo*
cansk	*reriv*	*pplea*
maspw	*rtnia*	*naanba*
geduf	*tsgae*	*miel*
ggyof	*eiwrt*	*wtbryrrase*

List 2 is easier than list 1, you will find, and list 3 is the easiest of all. Why? The problem with list 1 is that the sequences of letters, although they do not make sense in that particular word, go together quite often in English. "No," "can," "Ma," "ge," and "Gy" occur quite often, and their occurrence in these anagrams makes it more difficult to rearrange them and find the correct answer. On the other hand, the solution words have letter sequences that are not so frequent. For example, "swamp," one of the answers. The anagrams in List 2, on the other hand, are just the reverse. The scrambled letter sequences are rare, while the letter sequences in the solution are common (e.g., "lnnie," "linen"). The solutions to list 3 are all members of the same category, and so as soon as one or two is solved, the others become easier.

This example illustrates the importance of the availability of probable solutions and the flexibility with which they can be considered during the solution. If the solution is more probable than some incorrect arrangement of the letters, then the solution will be easy. (Duncan, 1969.)

recognizing the possibility for new and unusual functions. Other problems that have been studied along these lines follow.

Previous Experience. Once you have leraned to solve a problem in a given way, it is hard to change methods, even when a new method may be more appropriate. Abraham S. Luchins devised a set of problems in which the task was to transfer water among three jugs so as to obtain a given amount of water (Seltzer, 1966). The problems are shown in Table 11.2. Note that the first five problems can be solved by the general formula $B-A-2C$, and subjects learn quickly to apply the formula. The last one, however, can be solved in two ways: like the first five, or more simply with the formula $A-C$. Most subjects, once they learn the long way with the first problems, take the long way with the last one. If, however, they are warned "now think carefully," before the last problem they will be more likely to see the easier method.

There are many variations of this kind of problem that have been investigated by Luchins (e.g., 1954). The effects of set can be maximized or minimized, depending on the way the problems are presented.

Past experience may also affect problem solving through the operation of unstated assumptions. The two problems below illustrate this principle. The answers and the assumptions involved are shown in Figure 11.6.

1. Draw three rows of three dots each, about ½ inch apart in both directions. Then, using only four strokes and not picking up your pencil from the paper or retracing any line, draw a line through each dot.
2. Take four pencils of equal length and arrange them to form four equilateral triangles.

As you can see, unstated assumptions that are not really a part of the problem may hinder its solution. Presumably, these assumptions are learned and generalized from past experience.

The studies of problem solving, then, point to the critical nature of events

TABLE 11.2

Water-jar problems. The first five are for practice; the sixth one is the test problem

Problem	*Given Three Empty Jars:* *A*	*B*	*C*	*Measure This Amount of Water:*
1.	*21*	*127*	*3*	*100*
2.	*14*	*163*	*25*	*99*
3.	*18*	*43*	*10*	*5*
4.	*9*	*42*	*6*	*21*
5.	*20*	*59*	*4*	*31*
6.	*23*	*49*	*3*	*20*

Source: Adapted from Seltzer (1966).

during the preparation stage. The evidence presented (or the elements of the problem), together with the statement of the problem, must be mentally arranged in such a way that the solution is possible; this rearrangement is made easy or difficult depending on how the evidence is presented.

PROBLEM SOLVING IN GROUPS

While the individual thinker is by no means going out of style, it is a fact that much of the thinking that one does takes place in group situations. That is, one is often part of a group that is faced with some problem which requires a solution, and the *group* works on it. The questions have often been raised as to whether individuals think better alone or in groups, and whether a group situation is more efficient in terms of the ease with which solutions are developed, and the quality of the solution..

The group situation offers some advantages and some disadvantages, depending upon the details of the situation. It is particularly advantageous when the problem requires that a diversity of skills be brought together. If the different individuals in the group have the requisite skills, and if the leader of the group is a person who can facilitate communication among members and, in particular, can integrate the various contributions of the members, then the group situation may be superior to the same number of individuals operating as individuals (Maier, 1967).

Groups, however, have a way of creating pressure on individuals to develop particular solutions, especially if there is a strong person in the group who has particular biases about the solution. In many cases, the group has ended up accepting an inferior solution because of the insistence of a particularly strong member. In such situations group problem solving is inferior to individuals working separately.

One way to avoid such problems in the group situation is "brainstorming," a technique developed by advertising men. What is involved is a group of individuals getting together and accepting any and all ideas that are produced, without critical comment or evaluation. In a sense, individuals simply say what comes to mind. In a group, the large number of ideas that are produced and which, in turn, stimulate other individuals to produce ideas (i.e., a snowballing effect) ultimately result in many more alternative solutions to choose from and, indeed, offer the possibility that highly creative and original solutions will eventuate.

Logical Thinking

Logical thinking means thinking in accordance with the rules of logic, which is a well-developed branch of philosophy. The rules of logic apply to the question of the validity of *syllogisms*, which are statements that consist of two *premises* and a *conclusion*. Consider the following:

All men have two legs. (All *A*s are *B*)

All psychology students are men. (All *C*s are *A*)

Therefore, all psychology students have two legs. (All *C*s are *B*)

The first two statements are premises that are accepted as true without question (*logic is not concerned with whether the premises are in fact true but only whether or not the conclusion follows from the premises*). Given the two premises, the conclusion follows. The syllogism is valid. Now consider the next one:

All men have two legs. (All *A*s are *B*)

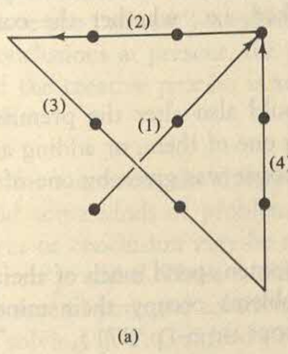
All psychology students have two legs. (All *C*s are *B*)

Therefore, all psychology students are men. (All *C*s are *A*)

Does the conclusion follow from the premises? The answer is no.

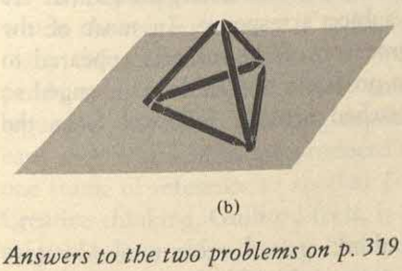
Basically, the rules of logic specify syllogistic forms that are valid and those that are not.

For a long time philosophers and some psychologists thought that the rules of logic were also the rules of thought, in that the rules described the processes of thoughts in those people who thought correctly. More recently logic as a description of human thinking has been questioned by psychologists interested in thought processes. It is not that logic is unimportant as a check, *after the fact*, of the validity of thinking. Rather, the question is raised as to whether or not the process of thinking is itself logical, and, if not, how it goes awry. Studies that have been done in this area suggest that in many cases people feel that they are thinking logically, but they make



Assumption: The angles made by the lines must occur at the location of the dots or you cannot go outside the array of dots.

(a)



Assumption: All of the triangles must lie in the same plane.

(b)

FIGURE 11.6

Answers to the two problems on p. 319 and the assumptions that commonly make them difficult to solve.

certain errors that cause them to accept invalid conclusions. Some of these errors are discussed below.

ATMOSPHERE EFFECT

One of the factors that leads people to accept false conclusions is the so-called *atmosphere effect*. Sells (1936) thought that the manner of statement of the premises established an "atmosphere" that partly determined the type of conclusion one would accept. If the first premise were negative, the atmosphere would be negative and he would be less inclined to accept a positive conclusion. If both premises were positive, then acceptance of a negative conclusion would be unlikely.

FACT VERSUS LOGIC

Another source of error in reasoning is the *failure to distinguish between what one knows or believes to be true and what is logically valid.* Henle (1962) had subjects read syllogisms presented as informal statements and decide whether the conclusions followed from the premises. For example, the following passage was used:

> I'm so glad we're talking about these problems. It's so important to talk about things that are in our minds. We spend so much of our time in the kitchen that of course household problems are in our minds. So it is important to talk about them (p. 370).

Many of the responses she obtained from subjects indicated that they were more concerned with whether or not it was important to talk about problems than with the question actually asked, i.e., whether the conclusions followed from the premises as stated.

CHANGING PREMISES IN MIDSTREAM

According to Henle (1962) subjects would also alter the premises either by changing the meaning of one, omitting one of them, or adding additional premises. For example, the following response was given by one of her subjects to the "syllogism" quoted above:

> Not correct logically. (a) A group of women spend much of their time in the kitchen; (b) thus household problems occupy their minds. . . . (c) Therefore it is important to talk about them (p. 371).

As you can see, the premise "It's so important to talk about things that are in our minds" was omitted from this subject's response. In most of the cases that Henle studied, the thought *processes* of the subjects appeared to be logical, but the material on which the processes operated was changed so that the conclusions that had been reached actually followed from the premises.

Creative Thinking

The fact that we are discussing creative thinking in a separate section does not necessarily imply that it is a different type of thinking from anything else we have discussed. It may be, and that is a question we must deal with.

On the one hand, creativity is a dimension for the evaluation of the *products* of thought, whatever their form may be. The term also refers to the *process* of thought, in that some processes may be creative and some not, and the question of whether to focus upon the product or the process is one which is very much an issue in psychology.

Creative thinking, such as Leonardo da Vinci must have spent much of his time doing, has outcomes that are new and original. But what about the delusional system of a paranoid schizophrenic (see Chapter 17). Is that also creative? In what way is schizophrenic thinking different from, say, the thinking that underlies a poem of William Blake? In other words, we may wonder about the role of public opinion in deciding whether or not a particular product is creative. We may also wonder whether or not there are any differences in the thought processes that produce results which are original and creative and those which are not. At what point does a product become bizarre rather than original? It would seem that if our focus is to be on the process, then we must not be too concerned with the *content* that is produced, particularly as regards its social value. Leonardo da Vinci may be said to have invented the airplane, but who would have appreciated his invention at the time he did it? It was not until 1900 or so that the idea of an airplane was thought to be feasible. On the other hand, some form of weighing of social value may be a part of the creative process, even if that part of society whose opinion is weighed is quite limited. Many modern artists, for instance, do not paint for the public at large but for a very limited group of other artists who may be expected to appreciate what they do and to have the "correct" standards for judging it. While we cannot come to any conclusions at present, the role of social judgment in influencing the nature of the creative process is something that will eventually have to be dealt with.

CONVERGENT AND DIVERGENT THINKING

Consider for a moment the difference between logical thinking as described above and some kinds of problem solving. In the case of logical thinking, the answer or conclusion may be said to be contained within the premises. Nothing new is added. There is only one correct answer. On the other hand, there are several potential solutions to the problems posed in the section on problem solving. J. P. Guilford (1967), a psychologist whose contributions to an understanding of the intellect will be discussed in more detail in Chapter 15, has suggested that we differentiate between *convergent* thinking, in which *the* correct answer is to be found, and *divergent* thinking, in which many different answers may be produced. While convergent thinking depends upon one's logical ability and his ability to categorize events unambiguously, divergent thinking depends upon fluency (i.e., the number and ease with which ideas are produced), flexibility, or the ability to shift from one frame of reference to another (cf. functional fixedness) and originality. Creative thinking, Guilford feels, is primarily divergent in nature. New and original relationships that are not necessarily logical must be seen; new twists to the meaning of old concepts are invented; and new frames of reference encompass events and ideas that might previously have been thought of as

unrelated. All in all, adhering to "correct" definitions and limited sets of factual relationships inhibits creative thinking.

What is the basis for divergent thinking? There are various views of this. Many psychoanalysts, following Freud (see Chapters 16–17) think that such thinking reflects the operation of unresolved conflicts and unacceptable emotions about which one is unaware and, if he were aware of them, would feel quite guilty. In other words a creative thinker has access to material that is not contained in consciousness (Kubie, 1958; Torrance, 1962b). Adherence to logic and rigid definitions would, it seems, tend to make one less ready to accept such material.

Another view, similar in many respects to the psychoanalytic view, is that creative people have a wider range of associations available as responses to a given stimulus situation. Mednick (1962) has devised a Remote Associates Test, several items from which are shown in Table 11.3. The idea is that a creative individual should be better able to think of words that are associates of the three somewhat diverse stimulus words. Several experiments have shown that scores on the Remote Associates Test are relatively highly correlated with ratings of creativity.

Studies of personality characteristics of creative individuals tend to support these notions. That is, creative individuals tend to be unconventional in a number of ways in addition to their patterns of associations and/or their tendency to have access to material that would not usually come into consciousness. Barron (1965) has assessed a number of individuals who were recognized as being creative in such fields as art, writing, mathematics, and architecture. He found that they were more self-centered, moody, and insistent upon maintaining their own individuality of judgment, even when their ideas were unconventional. They also tended to prefer asymmetrical, irregular patterns as opposed to symmetrical, regular ones, and to have a greater tolerance for disorder than less creative individuals.

All of these findings suggest that creative thinking requires at least a temporary suspension of thinking in the logical, convergent mode, together with a postponement of critical evaluation of the products of thought.

TABLE 11.3 *Sample Items Like Those in the Remote Associates Test*

Problem: Find a word that is related to each of the three words below

			Possible Answers
1. rat	*blue*	*cottage*	*cheese*
2. railroad	*girl*	*class*	*working*
3. surprise	*line*	*birthday*	*party*
4. wheel	*electric*	*high*	*chair*
5. out	*dog*	*cat*	*house*

Source: From Mednick, 1962.

Coupled with this requirement is a sensitivity to remote, abstract, and unusual relationships between events—relationships that may be more easily established at the unconscious rather than the conscious level. On the other hand, the products of creative thinking must be evaluated against the realistic, logical aspects of the situation. In the matchbox problem described earlier, one might think of a solution such as "magnetize the thumbtacks so that they will clump together. Then stick one into the board and the others will clump to it, making a platform for the candle." Such a solution, although new and original, would probably not work, and is also not within the ground-rules established by the statement of the problem.

The role of unconscious processes in creative thinking may not seem so far-fetched if you consider (1) the point originally made by the imageless thought school, that *introspection does not reveal any conscious content associated with thinking,* and (2) during the stage of incubation, which is apparently so important in the solution of some difficult problems, the thinker is not aware of the problem in question even though *something presumably is going on which eventually leads to its solution.*

Anatomical and Physiological Aspects

Thinking presumably is a function of the brain and must be considered as a biological, as well as a psychological, phenomenon. While we can in no way make any conclusive statements about what happens in the brain when someone thinks, there is a growing body of literature, including some rather sound experimentally based observations, dealing with this problem. While there is much more that could be said, we shall focus upon some recent work which suggests that the two sides of the brain (i.e., the left and the right hemispheres) function differently in thinking.

You will recall that language functions seem to depend upon the integrity of the left cerebral hemisphere, and that perceptual skills are disrupted by damage to the right hemisphere. Recently, some psychologists have suggested that this difference between the two sides may be related to basically different modes of thinking. The left side of the brain is, according to this view, more concerned with logical, analytic thought involving language, while the right side is more concerned with intuitive, imaginal, and other nonverbal modes of thinking.

One indication of this difference is given in a study by Kinsbourne (1972), who gave subjects problems that were mainly verbal or required the use of imagery in their solution. Understanding proverbs and platitudes is an example of verbal problems, while being able to describe from memory a complex scene or spatial layout is an example of a spatial type of problem. Kinsbourne used the direction in which subjects moved their eyes as an index of which side of the brain was more active. (A number of studies employing brain stimulation have implied that eye movements to the right indicate left-brained activity, while movements to the left indicate right-brained activity.) He found that there was a predominance of left movements (indi-

cating right-sided activity) when the problem was spatial, and a predominance of right movements when the problem was verbal. Thus it would appear that there are some overt indices of the functioning of the two halves of the brain.

Other research has indicated that the electrical activity of the two hemispheres is related to the type of problem being solved. If a person is solving a verbal problem of the sort mentioned above, then the level of alpha activity (brain waves occurring in the frequency range of 8 to 12 waves per second, which is an index of the relative absence of mental activity) in the right hemisphere increases (indicating relative quiescence of that hemisphere). If, on the other hand, the problem requires the use of remembered spatial relationships, then the level of alpha in the left hemisphere increases. Thus the type of problem being solved seems to be related to the location of activity in the brain (Ornstein, 1973).

You have already seen how persons with the "split-brain" operation, in which the corpus callosum is sectioned, functionally separating the two hemispheres, perform differently on tasks presented in the left as opposed to the right visual field (p. 106). All of these results point to the possibility that there are basically two kinds of thinking: right-brained thinking which is intuitive, nonverbal, imaginal, and perhaps more emotional; and left-brained thinking, which is verbal, rational, logical, and analytical.

The Development of Thinking

Since the thinking of infants is apparently quite different from that of adults, we are faced with the problem of how the thought processes of an individual evolve from infancy to adulthood. How can we characterize thinking at various points in development, and what are some of the factors that promote this development? The problem, like most developmental problems, is difficult to study because of the necessity for using language to communicate. An adult can at least describe what he is thinking about while he is solving a problem. A child may not be able to do this very well. A preverbal child certainly cannot do it. For this reason understanding thought in children requires more indirect approaches, in which the experimenter studies a child's behavior in response to problems presented to him.

The dominant figure in the field of cognitive development has been Jean Piaget, whose laboratory is in Geneva, Switzerland. For many years he and his co-workers have addressed themselves to the question of how the capacity for logical thinking characteristic of adults develops during childhood. While many other investigators have made both empirical and theoretical contributions to this area, Piaget's work has been the most influential and will, no doubt, continue to be so for many years to come.

Piaget's Theory

In Piaget's (1970) view, development progresses in *stages*; the thought processes in one stage are qualitatively different from those in another. Be-

fore discussing these stages it is necessary to outline some basic notions that apply to all stages.

First of all, development proceeds out of an interaction between the individual and his environment. *Operating on* the environment is essential for understanding it and being able to think logically and objectively about it. Information is taken in by the perceptual systems, but, at the same time, behavior alters the perceptual input so that one's idea of a particular object develops out of a relationship between sensory and motor processes. Feedback (Chapters 4 and 9) thus is quite important in development. The sensory-motor relationship is stored in the form of a *structure*, or *schema*, which is the *internal representation of the object and the operations one performs on it.* Cognitive development involves the gradual elaboration, or change, of these schemata as new inputs occur and new operations are made on them.

ASSIMILATION

The process whereby new information is related to an existing structure is called *assimilation*. The term has much the same meaning as in biology, in which it refers to such things as one's assimilating food into the basic structures (i.e., the cells of the body). That which is assimilated becomes a part of the structure. In a like manner new *information* (e.g., about cats) is assimilated into the internal structure relating to that topic (in this case, cats). Perhaps the structure originally contained such ideas as "soft and furry," "meows," and "purrs," together with representations of the consequences of certain actions such as stroking. Then a new action such as pulling the tail and new inputs (being bitten) occur. These are assimilated into the overall structure as they happen. Thus the idea of "cat" evolves as one's changing experience of cats—their behaviors and their responses to one's own behavior—is incorporated.

ACCOMMODATION

Old structures do not remain the same when new information is assimilated. Rather, new inputs require an adjustment of the structure. This process of altering is called *accommodation*. Its counterpart is also seen in biology. Genes, as you have seen before (Chapter 3) determine certain structural characteristics such as bony shape. However, the actual structure depends not only on the genes, but also on the particular nutrients that supply the raw material with which the genes must work. Variation in the raw materials that are assimilated will result in some modifications in the basic plan set down in the genes. In other words the basic plan *accommodates* itself to environmental variations. Piaget feels that the same thing happens in the development of one's conceptualizations of the world. Assimilations eventually force accommodation to occur so that the structures themselves change in a stepwise fashion.

Cognitive development, then, is seen as the product of the combined processes of assimilation and accommodation, both of which are essential. Not only must information be taken in, but existing structures must also be altered to accommodate the new information.

STAGES OF DEVELOPMENT

Piaget's research has led him to believe that the development of thinking occurs in stages. The stages are characterized by the type of mental operations that the child is able to perform, as well as the nature of the mental structures, or schemata, by means of which the environment and the child's relation to it are represented. Piaget has outlined four stages of development, called the *sensorimotor stage*, the *preoperational stage*, the *stage of concrete operations*, and the *stage of formal operations*. The characteristics of these stages are discussed briefly in the following sections.

Sensorimotor Stage (0 to 1.5 or 2 Years). During this period the focus is upon learning the relationship between movements and their sensory consequences. The process begins with simple repetition of responses, followed by some selection of patterns of movement that are particularly interesting because of their sensory consequences. Then the infant begins actively to explore certain of these movements and their consequences. The effects of this exploration set the stage for the development of the concepts of space, causality, and the concept of separate existence of external objects. The last concept, also known as *object permanence*, may seem a bit strange to you, since it is immediately apparent to most adults that objects retain their existence from one moment to the next. However, Piaget's idea, like that of other developmental psychologists, is that the infant has to *learn* to differentiate between himself and external objects, and that external objects exist even when he does not see them.

Preoperational Stage (2 to 7 Years). During this stage the child develops the ability to represent the world internally through the use of symbols, including language. These symbols come to be differentiated from the thing that is represented. However, at this stage abstract use of symbols is not possible, since the child has not yet developed the ability to acquire the rules for combining objects conceptually. Thought processes are *egocentric*, as in the previous stage. For example, communication by means of language is not usually accomplished with the recipient of the message in mind. Flavell (1963) found that children in this stage, when attempting to give verbal descriptions of a game to an adult who was blindfolded, would usually try to convey information by pointing and other gestures, which, of course, were useless to the listener.

Stage of Concrete Operations (7 to 12 Years). This stage is characterized by the development of the ability to represent a complete series of behaviors mentally, as evidenced for example, in the ability to draw a map indicating how to get from one place to another. At this point the child also begins to use the operation of conservation of quantities such as volume, number, weight, and mass. The conservation problem is depicted in Figure 11.7.

A tall container is filled with fluid and shown to the child. Then the fluid is poured from the tall container into one that is shorter and wider. The question is: Which container had more fluid in it? Surprisingly enough, children below about age 6 or 7 will say that the tall container had more in it,

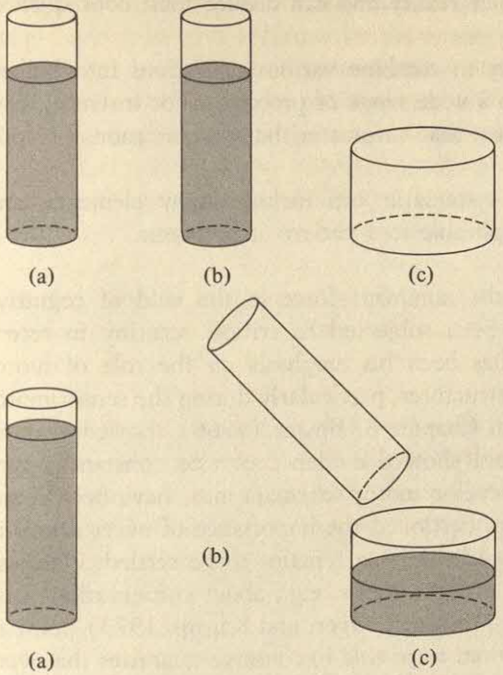


FIGURE 11.7 *The conservation problem. Until a child reaches a certain stage of development, he cannot say that the amount of liquid contained in the two glasses, (a) and (b), is the same, even after seeing the liquid being poured from (b) into (c).*

and will be insistent in spite of all manner of questioning on the part of the adult experimenter. Conservation of quantity appears somewhat earlier, at about age 5. At this age the child will be able to say, for example, that a clump of beans is just as many as a string of them which actually contains the same number.

Full achievement of conservation requires that the child develop the concept of *reversibility* of operations—i.e., one can reverse the operation of pouring the liquid and wind up with the same amount of water. During this stage the child becomes able to reverse many operations conceptually, but thinking is still tied to concrete objects. The concept of quantity *in the abstract* is not yet possible. In other words, abstract reasoning, which does not depend upon concrete objects, has not yet developed, and will not appear until the next stage.

The egocentrism characteristic of the earlier stages also begins to disappear, with the child's being better able to think from another's point of view.

Formal Operations. From age 11 to 12 on, the child begins to acquire adult modes of thinking. Unlike less mature children, he comes to be able to consider a problem from several different points of view, and entertain and evaluate several alternative solutions. He also develops the ablity to think deductively, which means that he can consider hypothetical situations with-

out being concerned about their reality and can deduce their consequences in a logical manner.

Of importance is the ability to combine various operations into higher-order operations that apply to a wide range of problems. For instance, solving problems in algebra requires that various arithmetic operations be combined into general solutions.

Formal thinking, then, is systematic, can include many elements, and utilizes operations that are applicable to a variety of problems.

EVALUATION

Although Piaget's theory is the dominant force in the field of cognitive development, his ideas have been subjected to critical scrutiny in recent years. One area of concern has been his emphasis on the role of motor processes in the development structures, particularly during the sensorimotor period. As was pointed out in Chapter 6, Bower (1966) showed that infants as young as 5 weeks old showed evidence of size constancy, even though their opportunity to develop motor schemata must have been somewhat limited. Other work has questioned the importance of overt action in the development of thought, and the issue remains to be settled. One also wonders about the generality of his notions, e.g., about conservation. In a recent discussion of this issue Mussen, Conger, and Kagan (1973) point to several instances in which children were able to conserve quantites that were meaningful to them, even though they had not reached the stage of concrete operations. We may presume that, given the tremendous increase in research in developmental psychology during the last 10 to 15 years, some of these issues will eventually be resolved.

The Role of Language in the Development of Thought

Thought involves the manipulation of symbols, and language involves symbolic communication. To what extent are the two processes tied together? Jerome Bruner and his colleagues (Bruner et al., 1966) argue that the way one thinks is intimately tied into the way his language permits him to represent reality. Bruner identifies three modes of representation of the environment, these modes developing at different ages. The first mode, *enactive representation*, involves coding the world in terms of the actions one performs on it. Movements, then, provide the basis for the first schemata formed by the infant. The second mode is *iconic representation*, in which the environment is represented in imagery. This mode becomes possible at about age 1 year and provides the beginning point for mental representation that does not depend upon action. One can have images without behaving. *Symbolic representation* is the third mode, which permits the representation of abstractions, including language. Indeed, the development of thinking is greatly facilitated by the capacity for symbolization of experience provided by language. In particular, more abstract forms of thinking are dependent upon language. Without such abstractions, thinking is limited to the enactive and iconic modes, which are distinctly limited in terms of the generality with which they can be applied.

The way children are trained becomes quite important in determining how they will think about things. To the extent that "learning by doing," (i.e., focusing upon enactive representation) is emphasized, the opportunity to deal symbolically with the environment will be lessened. Teaching that employs language, which must then be translated into the actions to be learned, will, on the other hand, foster symbolic development. Studies of different cultures have, according to Bruner and his colleagues, tended to support these ideas. Western children begin to use symbolic representation at a much earlier age than children in societies in which education is more oriented toward learning occupations by direct experience. The latter children continue thinking in the iconic mode for much longer.

Development of Creativity

The previous discussion focused upon how children develop the capacity for logical thought. Now, you may ask, in view of what has been said previously about differences between convergent and divergent thinking, how is it that one develops the capacity to think *creatively*—in other words, to engage in original thinking? While there have been numerous studies of the development of creative thinking (many of which are reviewed quite readably by Nash, 1970, pp. 381–398), unfortunately there is as yet little agreement about how to conceptualize creativity so as to be able to measure it.

There is some indication that creativity, in the sense of the child's generation of new and unique combinations of ideas, increases up to about age 4½ or 5, and then declines precipitously as he enters kindergarten. Torrance (1962a) has found increases in creativity up to grade 3, with a drop at grade 4, further increases up to grade 7, with another drop there. Other studies produced a somewhat similar pattern of results, particularly with respect to the drop at grade 7.

Considering the idea that divergent thinking requires access to preconscious mental processes, it would appear that at least two factors may be responsible for the seventh-grade slump. One of these concerns the growth of logical capacity, which occurs at about the same age. It may be that logical thinking and creative thinking are incompatible with one another, at least at first. Certainly, the increasing stress on the correctness of one's statements according to logical criteria would also bring with it negative reinforcement for divergent ideas that may not be supportable with logic. Another possible factor has to do with the increasing importance of social relationships that occur at about that age. Social relationships usually bring pressures to conformity, and unusual ideas or behaviors would be negatively reinforced from that quarter also. Whether or not one regains his creativity following this period must depend on a number of social factors which determine whether an individual will regain access to his preconscious processes and be able to integrate them with his newly developed logical capabilities.

Summary

Thinking, like language, is an extremely important human activity. As a psychological construct, thinking has been characterized in several different ways. One way views thinking as implicit behavior, such as subvocal speech and covert activity in other muscle groups. Thinking is also viewed as the internal manipulation of symbols—processes that *represent* external events. Representational activity may include images and verbal processes, although there is some indication that the process of thinking (as opposed to the contents on which the thinking operates) is not represented in consciousness (imageless thought). Thinking is also viewed functionally as the extension of existing evidence to yield a new product.

Studies with animals have indicated that some form of representational activity is possible, although in lower animals such as the rat there are distinct limitations.

The study of thinking includes concept formation, problem solving, logical (syllogistic) reasoning, and creative thinking. Concept learning involves learning to abstract common properties in otherwise different events and requires one to learn both the properties or attributes that are relevant to the concept and the rules that specify how the attributes are to be combined.

The solution of problems seems to proceed in stages, which have been termed preparation, incubation, illumination, and verification. Functional fixedness, which is the inability to rearrange the elements of a problem or to adopt a new "set," or approach to its solution, is a major hindrance to successful problem solving.

Logical thinking is the generation of conclusions from premises by the application of the rules of logic, and the question has been raised as to whether humans actually think logically, or whether logic is simply used as a check on the outcome of thought processes. Some experiments have shown that humans do think logically, in that they try to apply the rules. Logical errors, however, arise as a result of the atmosphere effect (unwillingness to draw negative conclusions from positive premises, and vice versa), the failure to distinguish between logical and factual statements, and the changing of premises in various ways in order to justify one's conclusions.

In the study of creative thinking one may focus on the process of thinking or on the product; the role of social values and convention in deciding whether a given product is creative or simply bizarre is quite important. Creative thinking has been termed divergent, as opposed to convergent, logical thinking. It seems to depend on one's having access to preconscious processes that would not ordinarily be represented in awareness, and which might hinder logical thought.

The study of thought development is dominated by the work of Piaget, who outlines several stages of development. The *sensorimotor stage* is characterized by learning of the relationship between movements and their sensory consequences. During the *preoperational stage* the child increases

his ability to use symbols internally to represent external events. *Conservation*, in which the concepts of volume, number, weight, and mass are understood in their abstract sense, develops during the later phases of this stage. In the stage of *logical operations*, adult forms of logical thought predominate. Moving through the stages involves the achievement of a proper balance between the processes of assimilation and accommodation. In *assimilation*, new information is taken in and related to one's internal view, or schema, of the world. In *accommodation*, the schema itself is altered in response to the new information.

The development of creative thinking is in some sense inversely related to the development of logical thought and sensitivity to social expectations. There is a sharp drop in creativity at about the seventh grade when logic and social factors become important. Creativity returns in some individuals and not in others.

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Motivation: Preservation of the Individual

12

In this chapter and the next two (*Motivation: Social Motivation* and *Emotion*) we shall consider topics with almost universal significance in regard to man's view of man, i.e., his conceptions of human nature. The long-standing issue of free will and determinism, for example, intersects with the study of motivation, while the question of rational versus irrational and emotional determinants of behavior comes to focus two chapters hence. As you might expect, we psychologists have no ready answers to these broad questions. Rather, you will encounter something of the psychological approach to issues related to the questions and perhaps will come to understand how the questions may be raised in such a way that they can be answered by making observations, i.e., by scientific approaches.

This chapter and the next one deal with the fact that most behavior is directed toward some goal. For the most part, it assumes that behavior is determined by *antecedent conditions*, that it does not "just happen" but is *motivated*. We shall examine some of the factors that motivate the behavior of humans and other animals.

Motivation may be considered from at least two different perspectives. First, one can make the distinction between biologically based motivation resulting mostly from innate processes that operate to preserve the individual and the species and the motivation toward goals that seems to be based

largely on learning. The term *primary motivation* is used to refer to the former; *secondary*, or *acquired motivation*, to the latter. As you will see presently, it is often quite difficult in practice to separate the features of a particular sequence of motivated behavior that are innately determined from those that are learned. Nevertheless, the distinction is usually considered a useful one.

The second perspective, which is the basis for the organization of the discussion in this chapter and the next, relates to motivation that is primarily *in the service of the individual*, in distinction to that which is intimately related to *other organisms*. Psychologists have not developed a handy term to apply to the first kind of motivation, but the term *social motivation* applies to the second kind.

You will see that the two perspectives are relatively independent of each other. There are biological as well as acquired aspects of both motivation for the individual and socal motivation.

This chapter is organized into four sections. First, there is a general discussion of the *concept of motive*, what it means and how it is related to other psychological concepts including emotion and instinct. Second, you will learn about *arousal*, an important aspect of motivated behavior which partly determines the strength of motivation, the persistence of motivated behavior, and, in general, the efficiency of functioning. Third, there is a rather detailed discussion of several *individually relevant motives*, including hunger, thirst, curiosity, activity, and several aversive motives. Fourth, the role of learning in the development of certain motives will be discussed. These include anxiety and motivation toward nonbiological goals ("tokens") such as money.

The Concept of Motive

A motive is a *construct* invented to explain certain facts of behavior. What are some of these facts? First of all, there are regular, more or less cyclical, variations in behavior (e.g., eating). Second, animals select particular goals and move toward them with persistence, overcoming obstacles and learning new habits if necessary. Third, depriving an animal of certain goals will result in increased persistence of behavior. In general, the construct motive is used to explain the energization and direction of behavior and its responsiveness to deprivation and to particular external stimuli. The question of how these factors interact is a very crucial one and is the subject of much research at the present.

The energizing factor is sometimes called "drive." It can be aroused by deprivation, which results in a need by the tissues of the body for the missing substance. Obtaining the appropriate goal may reduce the tissue need; eating, for instance, changes the physiological state of hunger. The fact that certain stimuli are sought when a drive is aroused is sometimes attributed to a conditioning process whereby stimuli associated with need reduction, such as

the sight or smell of food, the cafeteria line, etc., come to acquire some of the drive-reducing properties of the goal itself (Miller, 1951). The problem is complicated, however, by the fact that these same stimuli may also serve to *induce* a drive rather than reduce it (e.g., Morgan, 1943; Bindra, 1969). The fact of obesity makes it clear that deprivation is not essential for eating, and many individuals seem to have hunger drives that are *aroused* rather than satisfied by the sight and smell of food. Regardless of how this particular issue comes to be resolved, however, it is clear that both the energization and the direction of behavior must be accounted for.

As has been implied above, the concept of motivation is quite obviously related to that of reinforcement discussed in Chapter 7. Indeed, the fact that particular stimuli (goals) will reinforce behavior is the basis for the identification of many motives. For example, the fact that animals will work in order to obtain novel stimulation (discussed more fully later) has led some psychologists to speak of a curiosity motive. The law of effect, you will recall, states that responses that lead to a *satisfying* state of affairs will tend to be repeated, whereas those that lead to an *annoying* or painful state of affairs will tend not to be repeated. Presumably, these states of affairs are satisfying or annoying because of their relationship to particular motivational states within the animal. It is motivation, then, that makes reinforcement work.

Motive and Instinct

The concept of motive is also related to that of *instinct*. The study of instinctive behavior in humans and other animals has proceeded rapidly, primarily in Europe but also to some extent in the United States. Instinctive behaviors are unlearned patterns, usually fairly complex in form, quite often called into play by some rather simple stimulus that is said to "release" the behavior. Since the behavior is often stereotyped in nature, an instinctive pattern is sometimes called a "fixed action pattern." The internal processes that program its particular form are often thought to be prevented from occurring by an inhibitory process which may be "turned off," by the releasing stimulus. This internal mechanism is called an "innate releasing mechanism." Executing a fixed action pattern has motivational properties, since animals will often seek releasing stimuli that trigger the pattern, especially if such stimuli have not been present for some time (a cat playing with a mouse is a good example).

Many of the motivated behaviors to be discussed in the following sections may perhaps best be understood as the outcome of such processes, even in the case of human behavior. Eibl-Eibesfeldt (1970) discusses a number of examples of releasing stimuli for humans, mainly focusing on sexual and maternal behavior. For instance, the female bosom is a universal stimulus for sexual motivation; and maternal motivation may be evoked by pictures of creatures with rounded heads that are exaggerated in size relative to the rest of the body, as well as by infant cries.

While the present analysis does not focus in any great detail upon fixed

action patterns, releasers, etc., bear in mind that this type of analysis is quite applicable to the material discussed in this chapter, and further elaboration may be obtained from Eibl-Eibesfeldt (1970).

Arousal

Energization or arousal includes a complex set of processes that are manifested in several different ways. Arousal may be influenced by the internal state of the animal as well as by external stimuli, and its effects may be seen in behavior as well as in various physiological responses.

Behavioral Effects

Arousal may affect activity, as well as performance in specific tasks. When activity is measured in an activity wheel (Figure 12.1), it has been shown that aroused rats will spend more time running in the wheel than will quiescent rats. Females in estrus (heat), as well as chronically food-deprived rats, will run faster. Running is probably a species-specific behavior related to arousal in the rat, because *general activity* (e.g., simply moving about the home cage more) does not seem to be affected. Indeed, activity in the home cage is decreased with food deprivation. Actually, the energization of running in a state of estrus or food deprivation makes biological sense in that it will increase the likelihood of finding a mate or food, whereas simply running about in the cage would make little sense.

Performance in learned tasks is also influenced by arousal, as is shown in Figure 12.2. Note that with extremely high levels of arousal the effect is to

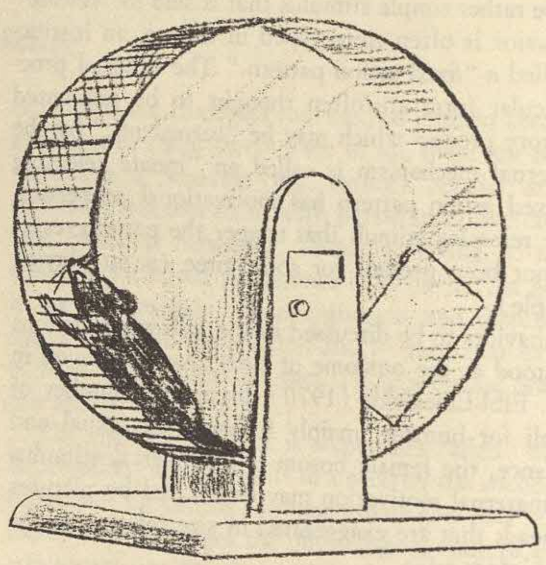

FIGURE 12.1 *An activity wheel. Animals, when aroused, will run in the wheel. The counter counts the number of revolutions, thus giving a measure of the amount of activity.*

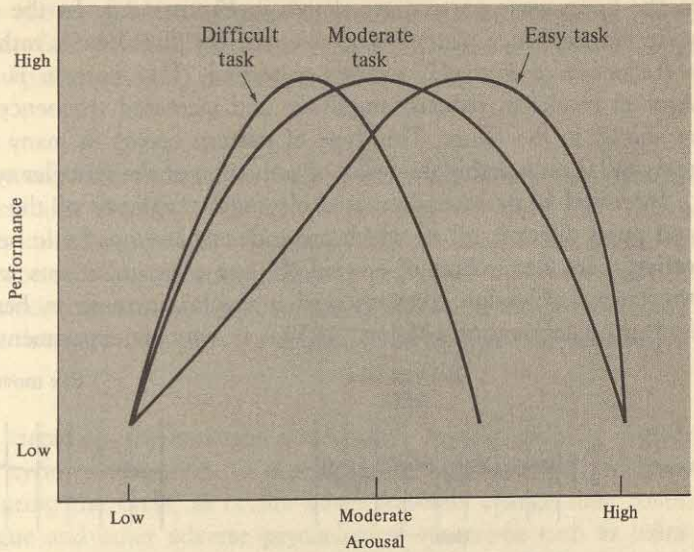

FIGURE 12.2

The Yerkes-Dodson Law. Each of the three curves indicates how the law operates for a given level of task difficulty. Difficult tasks are adversely affected by arousal before easier tasks are affected.

reduce performance, although there is an optimal level of arousal at which performance is enhanced. This relationship is called the Yerkes-Dodson Law, and applies in many different situations.

In one experiment testing this law rats had to make discriminations while swimming underwater. The reward for correct performance was air. The experimenter varied the difficulty of the task as well as the level of arousal (by depriving the animals of air for 0, 2, 4, or 8 seconds before beginning a trial). He found that the Yerkes-Dodson Law was correct. With the more difficult discrimination tasks, increases in arousal caused performance to deteriorate, while with the easier tasks arousal enhanced performance. In other words the point of optimum performance on the curve in Figure 12.2 depends upon task difficulty. Higher levels of arousal are tolerable for easy tasks but not for difficult ones (Broadhurst, 1957).

In another experiment, arousal was induced directly by stimulation of the reticular activating system (see Chapter 4). Monkeys were trained to perform a discrimination in which the stimuli were presented for only brief durations, 10 to 40 milliseconds. Both performance and reaction speed increased when the animals were electrically stimulated (Fuster, 1958). The effect was perhaps related to the fact that arousal makes an animal more attentive to external stimuli, particularly those that have in the past been associated with reinforcement (Bindra, 1969).

Physiological Effects

The effects of arousal may be seen physiologically by observing changes in the electroencephalogram (i.e., the pattern of electrical waves produced by the brain) as well as by changes in the autonomic nervous system. Changes

in the brain wave pattern are shown in Figure 12.3. In the calm, relaxed state the amplitude of the waves over the occipital lobe is rather high, with a frequency of 8 to 12 waves per second. This pattern is called *alpha.* Arousal results in reduced amplitude and increased frequency, called *beta*, as shown in the figure. This type of pattern occurs in many different animals and is presumably the result of activation of the reticular system.

Increased heart rate, decreased electrical resistance of the skin (GSR), and pupil dilation, all of which are indices of sympathetic nervous system activity, are also indices of arousal. In one experiment rats were subjected to water deprivation; they showed a regular increase in heart rate with increasing deprivation (Malmo, 1959). In another experiment male human

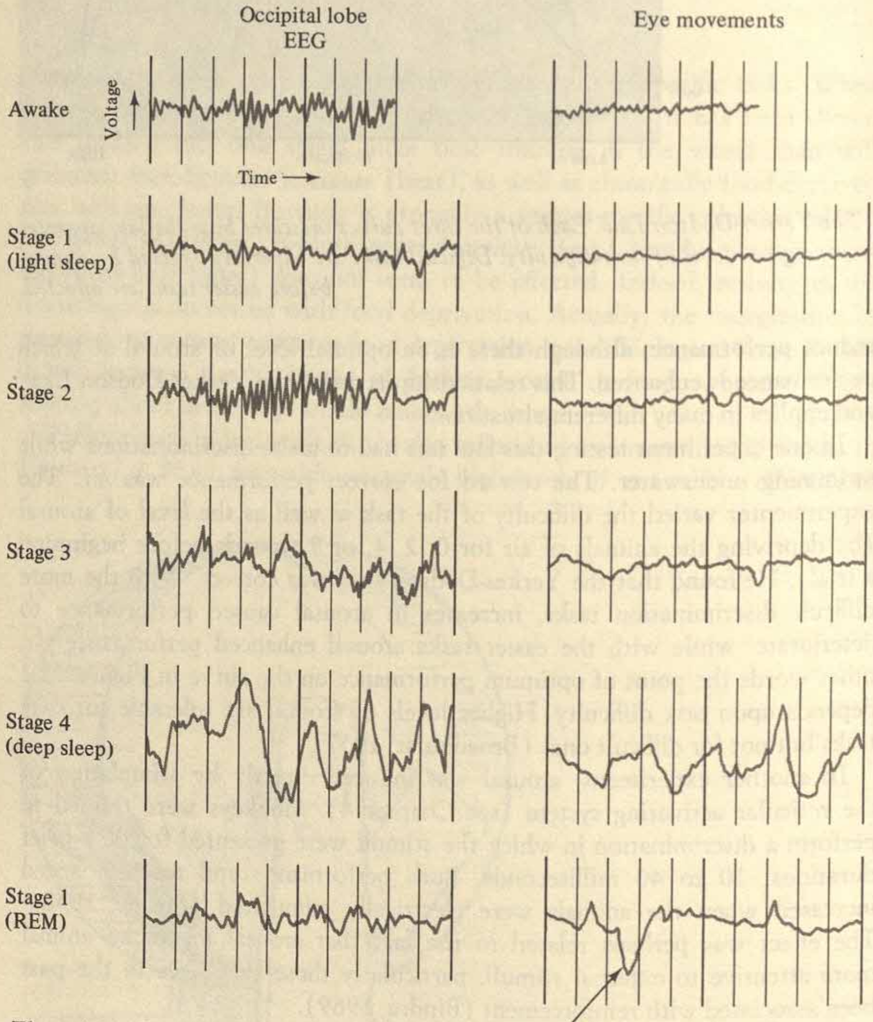

FIGURE 12.3 *Electroencephalographic records, showing the various stages of sleep and the record of eye movements that accompany them. Stage 1 (REM) resembles somewhat light sleep, but, as you can see, REM sleep is accompanied by eye movements, one of which is indicated by the arrow.*
From Kleitman, 1960.

subjects were shown pictures of nude or partially dressed females, and it was found that their pupils dilated much more in response to these stimuli than to neutral pictures such as landscapes (Hess & Polt, 1960).

Sources of Arousal

Arousal may come from internal, as well as external, stimulation. Internal stimulation includes *ciradian rhythms* (*circa*=around; *dies*=day) which recur regularly over long periods of time, as well as deprivation related to homeostatic processes (homeostasis refers to the tendency of the body to maintain relatively constant levels of certain chemicals in the bloodstream). For example, hunger and thirst are partly dependent on homeostatic processes.

CIRCADIAN RHYTHMS

Examples of circadian rhythms are widespread. People adopt a regular sleep–waking cycle, which tends to operate even when external props are absent. Disrupting the cycle, as occurs when travelers change time zones, produces fatigue and other adverse psychological symptoms such as irritability in some people. Blinded rats exhibit a high degree of regularity in their activity cycles over the course of several 24-hour periods, frequently exhibiting a cycle that is only 20 minutes off in 24 hours, almost as good as a cheap alarm clock (Richter, 1967).

The sleep cycle has been studied more than other circadian rhythms, although it is still not very well understood. Electroencephalographs taken during sleep show four distinct stages, shown in Figure 12.3. They are termed drowsing, light sleep, moderately deep sleep, and deep sleep, and there seems to be a regular recurrence of the patterns in order during a night. The return to Stage 1, drowsing, is accompanied by rapid eye movements (resulting in the acronym REM sleep for this stage). Subjects wakened during this stage usually report dreams.

Circadian rhythms, including the sleep cycle, seem to result from some active control on the part of the nervous system. Unfortunately, no one has yet discovered a single "pacemaker" responsible for these processes (Milner, 1970). There is some suggestion that the control may be of a chemical nature, perhaps involving the neurotransmitter serotonin (Chapter 4).

HOMEOSTASIS

The body is a very complex biochemical system, and in order for life to continue, it is necessary that certain conditions within the system remain relatively constant. Temperature, for instance, must remain close to 98.6° F in order for the many metabolic reactions that sustain life to proceed normally. Concentrations of chemicals such as oxygen, glucose, sodium, potassium, etc., must also be maintained within certain limits. When the blood level of any of these constituents deviates from the normal, corrective processes are brought into play. Too much glucose results, for example, in an increased secretion of insulin, a hormone that controls the rate of intake of glucose into the cells of the body and also its conversion into fat and subsequent storage. If there is too little glucose, then more is produced, usually from glycogen (which is the animal-equivalent to starch), which is

stored in the liver. An oxygen deficiency results in increased heart rate and faster breathing; the level of sodium is controlled by a hormone secreted by the adrenal gland, etc.

Most of the homeostatic processes operate automatically and involve very little in the way of behavioral consequences. At times, however, either when the normal bodily homeostatic processes do not function properly, or in cases of extreme deprivation, even these automatic processes produce changes in behavior. Then, too, there are homeostatic processes related to hunger and thirst, which ordinarily operate through behavior. The point is that when bodily conditions deviate from the normal, behavioral arousal may occur. Some of these behavioral effects have already been discussed. Later we shall go into more detail about two homeostatic processes, hunger and thirst.

EXTERNAL STIMULATION

External stimulation may also increase the arousal level. In fact, it appears that there is a need for an optimal level of stimulation, just as there is a need for a certain level of glucose, oxygen, etc., in the blood. The sensory deprivation experiments mentioned in Chapter 6, which showed that deprivation was quite unpleasant and, in many cases psychologically and physiologically debilitating, are a case in point. Too much stimulation, however, can have just as serious effects.

The effects of stimulation on arousal may also be demonstrated in simpler situations. Bartoshuk (1964) for example, found that when human newborns were presented with tones of different intensities, there was a greater increase in heart rate (i.e., more arousal) for the more intense than for the less intense tones. Other experiments using the EEG have found that subjects were more aroused when viewing complex pictures than when they were given simple, regular pictures (Berlyne & McDonnell, 1965). In other words, it would appear that the more intense the stimulation or the more information contained in it, the greater will be the arousal level.

Primary Motives

Primary motives are often considered to be unlearned, biologically relevant motives. However, even with these processes, it is difficult to determine whether learning does or does not have an effect. For instance, animals and people acquire specific likes and dislikes for foods, and in certain animals innate tendencies to eat in particular ways make it more likely that learning about specific foods will occur. The rat, for instance, tends to avoid new foods, or, if nothing else is available, to sample a small amount and wait. It will eat the food later only if it does not get sick in the next few hours. If it does get sick, then it will avoid the food in the future. Thus the innate hunger motive is moderated by an innate tendency to taste and wait which, in turn, increases the likelihood of learning about particular foods (Rozin & Kalat, 1971).

The list of motives can be long or short, depending on how much detail you wish to consider. We shall consider in this chapter hunger, thirst, stimulation and exploration, and several aversive motives, including pain.

Hunger

Hunger is complex, in that not only is it affected by states of deprivation, but also by periodically occurring stimuli associated with habitual modes of eating and other food-related stimuli, including sights and sounds. Furthermore, the rewards for eating come not only from the chemical composition of the food ingested, but also from the act of eating, the *consummatory activity* that one engages in.

Attempts to understand hunger motivation have focused upon (1) the initiation and cessation of eating, (2) the development of specific hungers, (3) the roles of nutrition and consummatory behavior as rewarding aspects of eating, and (4) the effect of situational factors associated with hunger and eating. These topics will be now discussed briefly.

INITIATION AND CESSATION

The hypothalamus contains cells that appear to monitor the level of glucose in the bloodstream. Since glucose is the main source of energy for the body, it makes sense that there would be some means for directly monitoring its concentration in the blood. When these hypothalamic cells are active, because of lowering of the blood glucose concentration, eating behavior may begin. Actually, the cells may be stimulated electrically with the same effect; damage to the cells resuts in cessation of eating and subsequent starvation. However, since specific hungers for a variety of substances may develop (e.g., vitamins, sodium, calcium), there must be other mechanisms that monitor other constituents of the blood, but they are not well understood.

Stopping eating, once it is initiated, depends upon a number of factors, including filling the stomach with food, dehydration of the cells of the gut in order to provide water for mixing with the ingested food, and engaging in a certain amount of consummatory activity such as chewing. These effects are funneled through another region of the hypothalamus which, when active, causes eating to cease. Damage to this area results in obesity, as you have already seen in the rat in Figure 1.1(a), whose hypothalamus was damaged in this area. These animals do not seem to be more hungry than normal—they just do not seem to be able to stop eating once they begin (see p. 344).

SPECIFIC HUNGERS

In addition to the general hunger mechanism, there are specific processes that result in the intake of a nutritionally adequate diet. For example, rats were raised in a situation in which the dietary requirements such as sugar, oil, and amino acids (the constituents of proteins) were provided in separate solutions. The animals selected adequate amounts of each, even when certain of them were made unpalatable by the addition of quinine (which tastes bitter) or were diluted with water (Rozin, 1968).

Various deficiencies result in preferences for foods containing the missing substance. A sodium deficiency will result in preference for foods high in

Obesity and Hunger

Obesity is a serious problem. Not only are obese persons less attractive physically than they might otherwise be, they are usually less healthy. They are more prone to diabetes mellitus as well as to heart disease. Obese persons are often regarded as being intemperate and unable to control their eating behavior; they may be castigated for lack of will power. On the other hand, many obese individuals claim that they can eat considerably less than a normal person and still gain weight, or at least not lose weight. Even those who manage to lose a little weight must constantly be on guard lest they put it back on again. In other words, obese people gain weight easily. These latter findings have led to the suggestion that perhaps obese individuals have a metabolic difficulty that makes them put on weight more easily and keep it on.

It is quite a leap from will power to a metabolic problem as possible explanations for obesity and thus, in spite of the immensity of the problem, we cannot at the moment say that it is well understood.

Recent behavioral studies by Schachter (1967) and his colleagues have uncovered some interesting facts about the eating behavior of obese people. Schachter and others have made the observation that in many ways the obese person is like the hypothalamic rat shown in Figure 1.1(a). With a lesion in the ventromedial hypothalamus, a rat will eat and eat, and will become quite gross. On the other hand, a hypothalamic rat is rather finicky about what he eats. He will overeat only if he is given food that is palatable. If otherwise nutritious food is made less palatable, such a rat will eat very little of it, in contrast with a normal rat that will eventually begin to eat the unappetizing food. The obese person is somewhat the same way. If given good-tasting food, he will eat considerably more than a normal person. However, if the food is not so good, he will eat less than a normal person, even if he is hungry.

Thus the suggestion has been made that the obese person is always less sensitive to the internal cues that signal hunger and satiety than is a normal individual, and therefore eats too much. On the other hand, he is quite sensitive to the external cues provided by the food itself, and seems to regulate his behavior by the taste of it, rather than by the way he feels inside.

Schachter conducted several experiments that demonstrate these points. In one of them he asked obese and normal individuals to miss the meal immediately before coming to the laboratory. He then gave them all the roast beef sandwiches they could eat. Next he subjected them to either high or low fear, by telling them that in the next part of the experiment they would receive a strong shock or a very weak one (merely a tingle). While they were waiting for the next phase of the experiment, they were asked to taste and rate some low calorie crackers, and were told that they could taste and eat as many as they wished. The normal subjects, as expected, ate fewer

crackers than the obese subjects, particularly in the high-fear situation. The obese subjects, on the other hand, ate more than the normal subjects in both situations. These findings indicated first of all that the obese subjects were less sensitive to the internal cues associated with the previously eaten food (roast beef sandwiches) than the normal subjects. Second, their response to fear was quite different, involving an increase rather than a decrease in food intake.

In another study Schachter found that obese subjects, when they thought it was dinner time (the clock in the laboratory had surreptitiously been set ahead from 5:20 to 6:05), ate more crackers than did normal subjects under the same condition. Again, the external cue (the clock), rather than their internal feelings, seemed to be the main factor controlling their eating.

These findings indicate that the explanation for obesity may require more than simply reference to "will power." It is more likely that subtle interactions between biochemical and psychological processes are involved. Nisbett (1972) has also noted that obese persons are much like hypothalamic rats in their eating behavior, but he has taken an additional step and suggested that the obese person, particularly if he is usually trying to cut down on the amount eaten, is actually in a state of chronic energy deficit. The fatty tissue, he maintains, is somehow involved in the adjustment of the hypothalamic mechanisms controlling eating so that a person's hunger motivational processes are actually attempting to maintain a particular body weight. In the obese person, that level of body weight is higher than normal. Thus it may in fact be true that obese persons are always hungry but remain obese.

As depressing as it may seem from the point of view of a fat person, overweight is determined mostly by the number *of fat cells, and this number is more or less constant from an early age onward. Dieting and even starvation do not decrease the number of fat cells but only the amount of fat they contain. They just sit there, waiting to be filled up again at the slightest amount of overeating. Furthermore, as Nisbett points out, trying to maintain a lower body weight exerts quite an emotional toll on the individual and his associates.*

Although these ideas are somewhat speculative at present, particularly the notion that the fat person has a physiological mechanism that attempts to maintain a high body weight, they certainly indicate that there is much to be learned about the problem. In a more general sense, they point out the rather complex relationships that must exist between anatomical, biochemical, and behavioral components of motivation.

salt, even in humans, which suggests an innate linkage between taste sensations and the control processes for eating. Rats fed a diet deficient in thiamine (a B-vitamin) develop an aversion to the deficient diet and will select one with adequate amounts when given the opportunity. In this case the

mechanism seems to be learning to avoid the deficient diet in much the same way as learning bait-shyness (Rozin & Kalat, 1971).

Although we cannot say much more about why specific hungers develop, there is a good bit of research activity in this area, and we may expect more answers in the future.

CONSUMMATORY BEHAVIOR

What role does eating, in contrast with nutrition, play in hunger? Pavlov discovered that when the esophagus was cut so that ingested food ran to the outside rather than into the stomach, eating continued even though no nutrition was provided by the food. Thus the act of eating must itself be rewarding. The same seems to be true of humans. Babies given milk in bottles that required very little sucking would, even though no longer hungry from a nutritional standpoint, continue to suck on other things such as their fingers.

On the other hand, nutrition without consummatory activity may also be reinforcing, as Epstein and Teitelbaum (1962) showed. They found that rats would work in a Skinner box when the reinforcement was having food injected into the stomach via a cannula, thus eliminating all consummatory activity.

SITUATIONAL FACTORS

Most people feel hungry at particular times and places and not others. Hunger may be evoked by the sight of food or of people waiting in a line to eat. On the other hand, if you miss a meal occasionally, the feeling of hunger does not usually persist on until the next meal. The hunger pangs disappear once mealtime is passed. Thus one learns to be hungry in particular situations.

The same phenomenon occurs with animals. Rats, for example, will adjust the amount of food eaten according to the schedule they are on. If fed once a day, they eat a lot; if fed several times a day, they eat an appropriate amount at each meal (Dufort & Wright, 1962).

Thirst

The problems involved in understanding thirst are much the same as those discussed above for hunger. There are processes controlling the initiation and cessation of drinking, consummatory activity per se is important, and situational factors exert their influence. Thirst, however, is somewhat simpler than hunger, since the main goal is only one substance, water. Since the main ideas have been developed in connection with hunger, and the principles are much the same, they will not be repeated here in any detail.

The basic biological requirement is to maintain the proper concentration of solutes in the bloodstream and in the cells of the body, i.e., to resist dehydration. As in the case of hunger, there are cells in the hypothalamus that monitor the relevant property of the blood, in this case, its osmotic pressure (osmotic pressure is the tendency for molecules of a solute to move across a membrane to a region of lower concentration). Minute injections of concentrated salt into the hypothalamus will produce much drinking in animals (e.g., Anderson, 1953, Greer, 1955), as will electrical

stimulation in these areas. Other factors, which probably also operate through the hypothalamus, include the volume of blood in the atrium of the heart and the amount of blood flowing to the kidneys.

What causes one to stop drinking? Apparently, the amount drunk is monitored by receptors in the mouth that "meter" the amount of water taken in. Animals with the esophagus cut so that all water drunk runs to the outside will drink only enough water to make up the deficit produced by deprivation. (Of course, they will begin to drink again quite soon, since the water ingested has no effect on the deficit.) Thus the amount of consummatory activity plays a key role in controlling water intake.

Stimulation, Curiosity, and Exploration

You probably do not have to be told what it is like to be bored or how dreary it can be just doing the "same old thing." You may also recall from Chapter 6 how subjects would forego $20 per day for doing nothing rather than remain in sensory deprivation. As was pointed out in that chapter, perceiving is a biologically necessary activity, and there seems to be a basic motive to insure that it will continue to occur. The fact that boredom is such an unpleasant state probably reflects the same point.

In recent years several investigations have all indicated that variety in stimulation functions as a primary goal, just like the other goals we have considered in this chapter. The phenomenon has been observed in a number of animals, including rats and monkeys, and in human beings.

It was mentioned in Chapter 6 that monkeys would work hard at tasks for which the only reward was a brief view of a toy train, and it was pointed out earlier in this chapter that maintaining a certain level of physiological arousal can be regarded as a motive. Furthermore, it was indicated that novel stimuli were more arousing than common ones. There is an increasingly large body of research demonstrating that novelty can be highly reinforcing, which supports the basic idea of the biological importance of this form of stimulation, and that many animals exhibit motivational processes which lead them to seek variety.

Activity and Manipulation

Being active and manipulating objects are motor functions for which there seems to be a distinct need. In fact, activity has some of the aspects of a homeostatic motive, in that the strength of the motive seems to increase with deprivation. In one experiment, for example, rats were kept in a small box that prevented gross body movements. Different animals were deprived of activity for different periods of time, and then all were tested in an activity wheel. The results were that the longer the deprivation, the more running was done (Hill, 1956). In another study the situation was arranged so that a lever press would release a brake on the wheel for 30 seconds, permitting the animal to run for that time. Rats would press the lever in order to release the wheel more than would control rats whose levers were not connected to the brake mechanism (Kagan & Berkun, 1954). This finding illustrates that the need for activity functions like a biological drive.

Manipulation of objects seems to have similar motivational aspects in some species. Monkeys, for example, will learn discrimination tasks in which the only reward is to pick up an object to manipulate. They will also solve latch box puzzles for no additional incentive other than the action involved (Fig. 12.4).

Aversive Motives

The world is full of harmful things, and it is not likely that any species would have survived to this point if there were not rather basic, biologically determined tendencies to avoid or to escape certain kinds of situations.

Pain is a universally aversive experience, and almost any animal will attempt to escape from the presence of painful stimuli. Electric shock is a kind of painful stimulation that is easy to apply and control, and conse-

FIGURE 12.4 *This monkey is solving the latch problems with no apparent motivation other than curiosity or manipulation. There is no other reward or punishment associated with the problems.*
Courtesy of Harry F. Harlow. University of Wisconsin Primate Laboratory.

quently psychologists have used this form of stimulation in order to train avoidance or escape behavior. It seems to be a very potent stimulus for fear. Shock, however, is not a biologically appropriate negative stimulus, in that it is quite unlikely that specific escape mechanisms related to shock would have evolved. It is, on the other hand, quite effective, and so much of what we know about aversive motivation comes from studies using electrical shock.

Animals come equipped with a number of more specific aversive reactions to particular kinds of stimuli. Some birds who are the natural prey of hawks will, for example, hide when presented with the silhouette shown in Figure 12.5. They will hide only when the direction of movement is as shown, however. When it is reversed, the hiding does not occur. As you can see, two different birds—a hawk in the first instance and, say, a goose in the second—might be represented by the two directions of movement. Large shadows crossing the visual field of many animals will stimulate hiding or freezing, since the shadow could very well indicate a predator.

Higher animals exhibit other types of unlearned fears. Monkeys, for instance, seem to be innately afraid of snakes, and a horse may also bolt in the presence of a snake. Furthermore, some primates seem to exhibit fear when presented with stimuli that are partly familiar and partly unfamiliar. A head or lifelike casting of a monkey or chimpanzee will create a great deal of agitation when presented to monkeys or chimps in a colony.

Aversive motivation is also associated with some kinds of foods or certain tastes. Quinine is a bitter-tasting substance which, when dissolved in milk or water, will reduce the intake of the adulterated substance even in the face of mild (but not severe) hunger.

While aversion to quinine seems to be innate, other aversions are learned quite easily. The development of bait shyness in rats has already been mentioned. Foods that make an animal sick during the hour or two following ingestion tend to be avoided in the future. This reaction occurs whether or not the food itself is what makes the animal sick. If animals are made sick by injections of apomorphine, a substance that induces nausea, then perfectly harmless foods eaten within one or two hours of the injection will be avoided in the future. This kind of reaction also occurs in humans. One

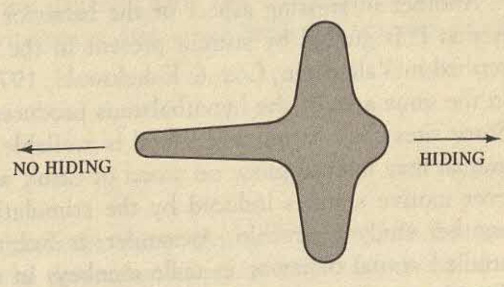

FIGURE 12.5

This figure will elicit hiding in young birds when passed overhead in the left-to-right direction but not in the right-to-left direction.
Tinbergen, 1951.

woman, for example, was quite nauseated during pregnancy. A boarder in the same apartment building habitually cooked turnip greens so that the smell became associated with the nausea. As a result, for a number of years afterwards the woman had feelings of nausea whenever she smelled turnip greens cooking. (The food itself had never been aversive before. In fact, it had been a favorite vegetable.)

Perhaps this learned aversive motivation has evolved as an adaptively efficient way to insure that undesirable foods will be avoided, but which, at the same time, conserves genetic material (DNA), since it would be highly inefficient to attempt to provide innate aversive responses to all potentially harmful substances (Rozin & Kalat, 1971).

Electrical Brain Stimulation

James Olds (Olds & Milner, 1954) made an accidental discovery that has had a revolutionary impact on the study of motivation. He discovered that rats would work until exhaustion in order to receive mild electric shocks to certain areas of their brains, principally in the limbic system. As a consequence, some people have called these areas "pleasure centers." The phenomenon of self-stimulation was mentioned in Chapter 4, and little more need be said, except to point out that a variety of different behaviors can be reinforced by this form of stimulation and that rats will ignore other biologically appropriate drives in order to receive such stimulation.

That animals will work for such stimulation raises some interesting questions in connection with motivation. Does the electrical stimulus simulate in some way the reinforcing effects of other external stimuli and thereby reduce drives? What is the relationship between electrical brain stimulation and other motives? At this point there are a number of interesting speculations but little certainty with regard to answers to these questions.

In this connection it is important to note that electric brain stimulation is not only rewarding in some instances, but it also seems to induce the animal to perform motive-related behavior. Stimulation in some of the same sites in the brain that will reinforce bar pressing will also evoke behavior such as eating, drinking, or copulating. Why should brain stimulation in a given area seem to *arouse* motivated behavior in some circumstances and *reduce* motivation in others? At this point no one knows why.

Another interesting aspect of the behavior induced by brain stimulation is that it is guided by stimuli present in the environment. Valenstein (described in Valenstein, Cox, & Kakelowski, 1970) has found that stimulation in the same area of the hypothalamus produces a variety of different effects. Some sites elicit eating when food is available, but, if it is not available, the animal may instead gnaw on wood or drink water. The expression of whatever motive state is induced by the stimulation is then quite variable. In another study (Perachio, Alexander, & Robinson, 1968) the investigators studied sexual behavior in male monkeys in response to brain stimulation. Certain sites would, when stimulated, immediately cause the animal to mount a female (Figure 12.6). However, in later work it was found that if the experimenter introduced another male, socially more dominant than the

FIGURE 12.6

A male monkey mounting a female. The "hat" on the male is a radio receiver by means of which his brain can be stimulated electrically. The electrical stimulation induces him to mount the female.
Photograph courtesy of Dr. Adrian Perachio, Yerkes Regional Primate Center.

subject, into the cage as well, the dominant male would inhibit the sexual behavior of the stimulated subject. A subordinate male, on the other hand, would not cause such inhibition. Thus, once again, the outcome of a particular form of brain stimulation depends upon the animal's perception of significant features of his environment and upon particular learned social patterns.

Secondary Motivation

As indicated before, secondary goals are quite important factors in behavior. This fact is true regardless of the theoretical issues and the fuzziness of the concept. Furthermore, while it is quite hard to integrate the area in any reasonable manner, there is a considerable body of literature dealing with the topic. We shall consider two types of secondary motivation: seeking

positive secondary goals, or tokens; and avoiding stimuli associated with primary aversive stimuli.

Positive Tokens and Incentives

It does not take a very sophisticated psychology of motivation to realize that humans will work for goals that are only indirectly related to primary reinforcement. Several questions arise, however, in connection with this phenomenon. One may wonder, for example, how extensive it is. Does it occur in all animals or is it a uniquely human phenomenon? What kinds of tokens will work, and how direct must their relationship to primary reinforcement be? What kinds of "primary" reinforcers can support the development of secondary, token goals?

With regard to the effectiveness of tokens as rewards in animals, it was shown long ago by Wolfe (1936) that chimpanzees would work in order to receive poker chips that they could use in a vending machine to obtain raisins or grapes. If the machine were not available for some time, they would even hoard the chips and wait for the opportunity to spend them. It was also reported that they would work for chips of a particular color if that color were exchangeable for, say water, and the animal were thirsty. Other colors, exchangeable for food or a period of play, would be sought under appropriate motivational conditions. In other words, not only would they work for a secondary goal, they would work for a particular goal that was relevant to the particular needs of the moment.

Other experiments have shown that a potential secondary goal can become effective if it is simply paired with a primary goal, as in classical conditioning. For example, rats would learn to press a bar for food more readily if the food were accompanied by a stimulus such as a light, a tone, or a clicking sound, which had been previously paired with food (Figure 12.7). It is likely that the animals learned through classical conditioning that the neutral stimulus predicted the occurrence of food, and that this predictive power served to facilitate later learning of the instrumental response.

Another experiment with children also showed that a neutral stimulus whose occurrence predicted the occurrence of a valued reward would function as a goal. Longstreth (1971) used first graders and a group of fourth and fifth graders in his experiment. A neutral stimulus object (a piece of wood or a paper clip) could be inserted into a hole. Next a response was made that would often result in the delivery of a marble. The marble could then be exchanged for money (the valued reward). Along with the money was presented a second neutral stimulus (a paper clip or a piece of wood, i.e., the opposite of the first neutral stimulus). In other words, one of the stimuli, the one inserted into the hole, was necessary in order to get the marble, which was exchangeable for the money. The second neutral stimulus was *associated in time* with the money but was not necessary in order to receive the money.

Which of the two neutral stimuli would be more valued, i.e., chosen, in a second phase of the experiment in which the subject could make a choice

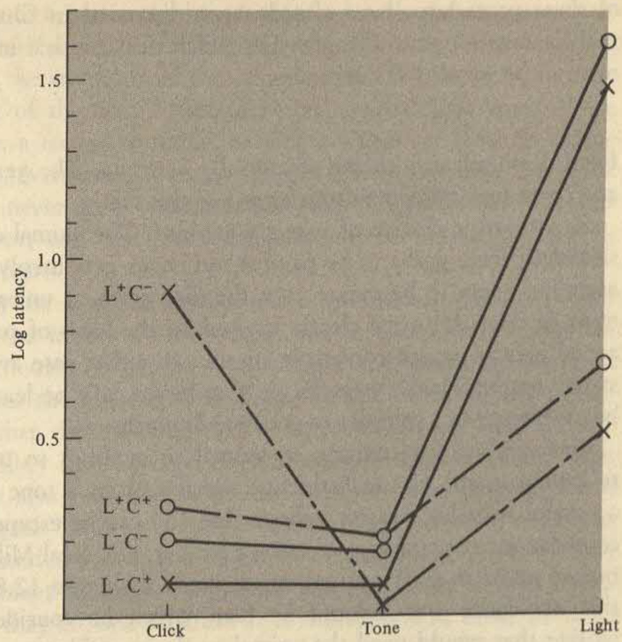

FIGURE 12.7

The latency of response to a click, a tone, or a light, after various pairings of these stimuli with food in a Skinner box situation. In group L+C−, the light had been previously paired with food and the clicks not. For group L+C+, both light and click were paired with food; for group L−C−, neither light nor click was paired with food, and for group L−C+, the click, but not the light, was paired with food. Note that response to the stimulus on a later occasion was much faster when it had been paired with food. The tone was paired with food under all conditions.
From Trapold & Winokur, 1967.

and get either? The answer is that the older children chose the stimulus that was used to get the marble, etc., but only if they thought that they could thereby get more marbles and money. The younger children made no consistent choice, probably because they were not old enough to understand the relationship between the neutral stimulus and the money. Thus we seek secondary goals not necessarily because they have been associated with reward in the past but because they are predictive of future rewards. Otherwise, the neutral stimulus that was presented together with the money would have been valued also. This interpretation of the effects of secondary goals is, of course, quite "cognitive" in its orientation. It assumes that humans and other animals are capable of predicting consequences of particular states of affairs, and that this prediction affects their subsequent behavior.

Other indications of the effectiveness of tokens as incentives for performance come from explorations in the use of behavior modification techniques in the treatment of personality disturbances, the management of psychiatric wards in hospitals, and classroom management in schools. Some

of these procedures have already been discussed in Chapter 7, and others will be mentioned in Chapter 18, which deals with methods for the treatment of personality disturbances.

Aversive Secondary Motivation

Painful stimuli are almost universally aversive. The yearly sale of aspirin and other pain-relieving drugs attests to this fact.

Situations predictive of pain are avoided. The animal acts as though such situations were going to be painful and never gets involved. Although some aversions seem to be innate (see the discussion of unlearned fears above), most of them are quite clearly learned on the basis of past experience with actual painful or other aversive stimuli. In either case aversive stimuli have strong motivational properties, in that habits will be learned, obstacles will be overcome, etc., in order to get away from them.

One method for training an animal to avoid is to provide it with the following items: (1) a distinctive signal such as a tone that precedes, (2) a painful stimulus such as a shock that (3) can be escaped by performing a response such as running, crossing a barrier, etc. Neal Miller (1951) trained rats to avoid in such a situation, depicted in Figure 12.8. He hypothesized that avoidance was induced by fear, which he considered to be both a motive that would prod the animal to do something to eliminate it, and a response to the shock. The fear itself, he reasoned, came to be conditioned (classical conditioning) as a response to being placed in the white compart-

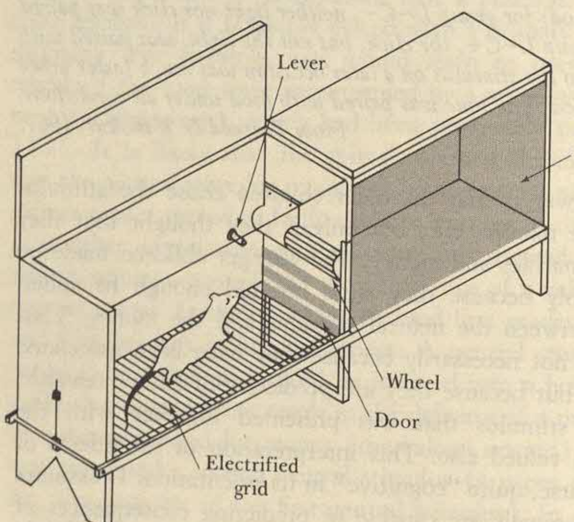

FIGURE 12.8 *Apparatus used to study the acquisition of fear as a drive. The rat, shortly after being placed in the white compartment, was shocked unless it first moved into the black compartment. Once avoidance was well established, the animal was required to perform a new task, either pushing the lever or turning the wheel in order to open the door into the safe compartment.*
From Miller, 1948.

ment of the box, since being in the box was paired with the electric shock. Once the response of fear was learned, it served as a motive to do anything that would remove the animal from the situation which aroused it, i.e., the white compartment of the box. Miller went on to show that some of his animals would learn a *second* response, turning a wheel, in order to escape from the white box, even though, in that part of the experiment, the shock was turned off and never again administered. Thus it appears that fear was acquired as a motive, and that the animals would do something new in order to reduce the fear.

It is possible that the stimulus conditioned to produce avoidance is functionally similar to the tokens or incentives used in the positive situation. Thus the neutral stimulus or CS, becomes a signal that shock is imminent. Its termination, once the avoidance response is made, then signals safety. This analysis is rather directly indicated by experiments by Rescorla and LoLordo (1965). They first exposed dogs to periodic electric shock. During the shock they also presented a neutral stimulus that became, so to speak, a "danger signal." During periods when the shock was off, there was a second neutral stimulus which, you might say, signaled safety. In the next phase of the experiment the dogs were tested in a previously learned avoidance task in which they crossed a barrier in a shuttle box in order to avoid shock. Occasionally, the safe signal or the danger signal was presented. What happened was that the safe signal tended to inhibit the animals' behavior, while the danger signal tended to facilitate it. Apparently, the signals for safety or danger served to increase or decrease the motivation to avoid.

Conditioned danger signals may also disrupt ongoing behavior. A rat that has been exposed to shock in the presence of a tone will, when the tone is subsequently presented, exhibit an instinctive defense reaction such as freezing, jumping, or running (Bolles, 1970). Such a response is usually incompatible with other behavior, such as pressing a lever in a Skinner box, and therefore suppresses the other behavior. This suppression is called a *conditioned emotional response* and is used quite often in experimental analyses of emotional behavior (Figure 12.9).

These defense reactions may be conditioned in a variety of circumstances, as responses to a variety of signals and, in general, when they occur, they will disrupt other forms of ongoing behavior. In humans the range of defensive reactions that may be invoked is also probably quite large and may account for the learning of various irrational behaviors such as compulsions, to be discussed later (Chapter 17).

The Persistence of Secondary Motivation

One of the aspirations of investigators of secondary motivation has been to be able to explain the persistence of learned goals in human beings, particularly where the goal seems to be relatively unrelated to any primary motivation. Goals such as money, esteem, love (as distinguished from sex), and the pursuit of intellectual interests, as well as values such as law and order, and patriotism, all seem to be quite persistent. Unfortunately,

Addictive Drugs and Motivation

Many of the facts of drug addiction are common knowledge. For example, the newspapers and magazines are full of information to the effect that opiates (derivatives of the opium poppy) such as heroin, morphine, and codeine can produce a physical dependence, i.e., a physiological need for the drug. In other words, an individual's body tissues, particularly brain tissue, acquire a need for the drug in order to function normally. Withdrawal of the drug can result in rather severe symptoms, somewhat like a very bad case of influenza, including cramps, soreness, dizziness, nausea, chills, and fever.

The needs of the addict for the drug quite often assume a primary motivational function. His life becomes organized around the problems of obtaining a satisfactory amount of the drug. The development of dependence is further complicated by the phenomenon of tolerance, in which more and more of the drug becomes necessary to produce the effects. Thus it does not appear out of the question to speak of acquired primary motivation in this connection. In other words, by means of some as yet undiscovered chemical process, a physiologically based motive with many of the properties of hunger and thirst comes to be developed.

Experimental studies of the development of drug dependence are necessarily limited for the most part to the use of animal subjects, since the ethical problems in experimentally addicting human beings appear insurmountable. In recent years, however, there has been a rather large amount of research with animal subjects, particularly primates such as monkeys. Many such studies have suggested that the development of dependence and its consequences for behavior are quite complex, and conditioned responses to various aspects of the drug-taking environment provide further complications. For example, research by Goldberg (1971) and his colleagues has indicated that there are many ways in which environmental stimuli associated with the injection of a dose of morphine can come to serve as discriminative stimuli (see Chapter 7) for the self-administration of the drug in monkeys.

These findings were obtained in a series of studies in which the morphine antagonist nalorphine was used. Nalorphine, when administered to a morphine-dependent animal, will bring on withdrawal symptoms in a few minutes, which last for several hours. Monkeys were first trained to administer morphine to themselves by pressing a lever, which caused a standard dose to be administered through a permanent tube in the jugular vein. After one or two months on this schedule the monkeys were quite dependent on morphine and administered it to themselves at a rather stable rate.

In the next step the monkeys were presented with a flashing light, followed by an injection of either salt water or nalorphine. The salt water had no effect, but the nalorphine, of course, brought on all the withdrawal symp-

toms. The monkeys quickly learned to give themselves more morphine in response to the nalorphine, which seemed to counteract the withdrawal symptoms. As you would expect, there was, at first, no such response to the saline. However, after the experience with the nalorphine, the monkeys also began to increase their rate of morphine administration in response to the saline injection. Tests revealed that the light, which was intended to be the CS, was not effective in increasing the morphine-taking, but the stimuli associated with the injection were. In other words, they had learned to increase their dose level in response to stimuli that had been associated with the withdrawal symptoms.

Other observations reported by Goldberg indicated that some of the animals seemed to show the nalorphine response simply when they were placed in the experimental apparatus, indicating that the situational cues associated with the withdrawal can come to bring on some of its symptoms.

These findings are important because they suggest that once the withdrawal-motivated behavior has been conditioned to other stimuli, these stimuli can come to bring on the symptoms, and the consequent return to the drug. Perhaps this is one of the reasons why "cures" for opiate addiction are so difficult to achieve. There are too many external stimuli that have become associated with the consequences of deprivation. These stimuli, through conditioning, can bring on the same response as that obtained with actual deprivation.

Other findings indicate that the effects of morphine are quite long-lasting, persisting for quite some time after the withdrawal has been supposedly completed. For example, monkeys that had been addicted to morphine for 2 months were deprived of it for 3 months, their withdrawal taking place without nalorphine. Then, at the end of the 3-month-period they were given various dose levels of nalorphine. It was found that these animals, even though they had had no morphine for 3 months, still reacted to the nalorphine, whereas animals without previous exposure to morphine required much stronger doses to produce a reaction. Thus there are apparently some long-term physiological changes associated with taking morphine that persist even over a long period of abstinence. The implications of these findings speak ill for the chances of rehabilitation of addicts simply through withdrawal from the drug, at least without some rather concentrated new learning, tending to counteract the behavioral effect of the long-term physiological changes.

attempts to establish long-term, acquired goals by experimental means have been rather unsuccessful, since subjects will usually quit working for the goal when its relationship to the primary incentive is discontinued. Such was the case for the chimps in the token reward study mentioned above, and such has been the case for most other studies as well. The main exception seems to be in the case of secondary aversive motivation. Avoidance habits are quite resistant to extinction, even when the primary reinforcers are discontinued. The lack of permanence of positive goals in laboratory

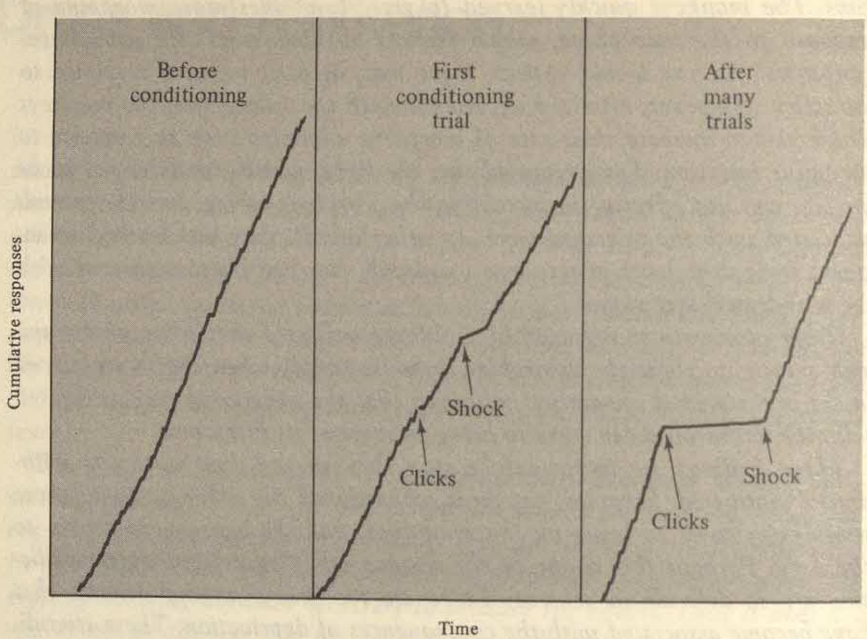

FIGURE 12.9 *Acquisition of a conditioned emotional response. An animal is first trained to press a lever for food or water reward in a Skinner box. After lever pressing is well established, indicated in the left-hand panel, the animal, while it is pressing, is presented first with a series of clicks and then with electric shock. The clicks and the shock terminate together. Note that as indicated in the middle panel, the clicks do not affect lever pressing, but the shock causes a brief pause. After a number of trials, however, in which the clicks and shock are paired, the clicks cause a cessation of bar pressing, which, however, is renewed after termination of the clicks and shock. Presumably, the emotional response to the clicks is learned, based upon their being paired with shock; this response disrupts the other behavior, bar pressing.*
After Hunt & Brady, 1951.

situations, then, constitutes a major problem in attempts to generalize such studies to human behavior.

Summary

The study of motivation is concerned with the goal-directed aspects of behavior. Motives may be considered as relating primarily to individual survival (e.g., hunger, thirst) or to one's social behavior (sex, aggression). Motives that are mostly biologically based and unlearned are called primary motives. Secondary motives are learned. The term motive is a construct which refers to the fact that behavior is energized under certain circumstances, and is directed toward certain stimuli and not others.

A term related to the energization of behavior is arousal. An increase in arousal level is revealed in several ways: by increased activity; by a curvilinear relationship between arousal and performance efficiency, whereby efficiency is maximal for a moderate amount of arousal; and by increased attentiveness to external stimuli. Arousal also is exhibited in physiological responses such as the electroencephalogram, the galvanic skin response, and pupil dilation. Arousal levels are affected by the operation of circadian rhythms, homeostatic processes resulting from deprivation of certain biologically necessary substances, and external stimuli.

Primary motivation is related to the functioning of areas within the hypothalamus. Stimulation of these areas produces the appropriate behavior such as eating or drinking, and damage produces a temporary cessation of the behavior.

Control of primary motivation involves a complex interaction between activity in the hypothalamus and other limbic system areas and other sources of stimulation, both internal and external. Eating, for instance, is affected by the sights, sounds, tastes, and smells of food, the situation in which food is encountered, the fullness and emptyness of the stomach, and the amount of consummatory activity (e.g., chewing, swallowing), as well as by activity in the hypothalamus.

There also seems to be a basic need to engage in a certain amount of activity, to explore and receive novel stimulation, and to manipulate objects. Learning will take place when the only reward is novel stimuation or the opportunity to explore. Conversely, deprivation of activity or stimulation is noxious.

Through processes of conditioning, neutral objects may become either positive or negative secondary goals if their presence has been found to predict the occurrence of a positive or negative primary goal. The presentation of stimuli that predict positive reinforcement will itself be reinforcing, and the presentation of stimuli predicting punishment will in itself be aversive. Various new behaviors may be learned with the use of secondary goals as reinforcers, although there seem to be limits as to the kinds of avoidance behaviors that can be established. Avoidance learning may be limited to a certain extent to so-called species specific defense reactions that naturally occur in response to painful stimulation.

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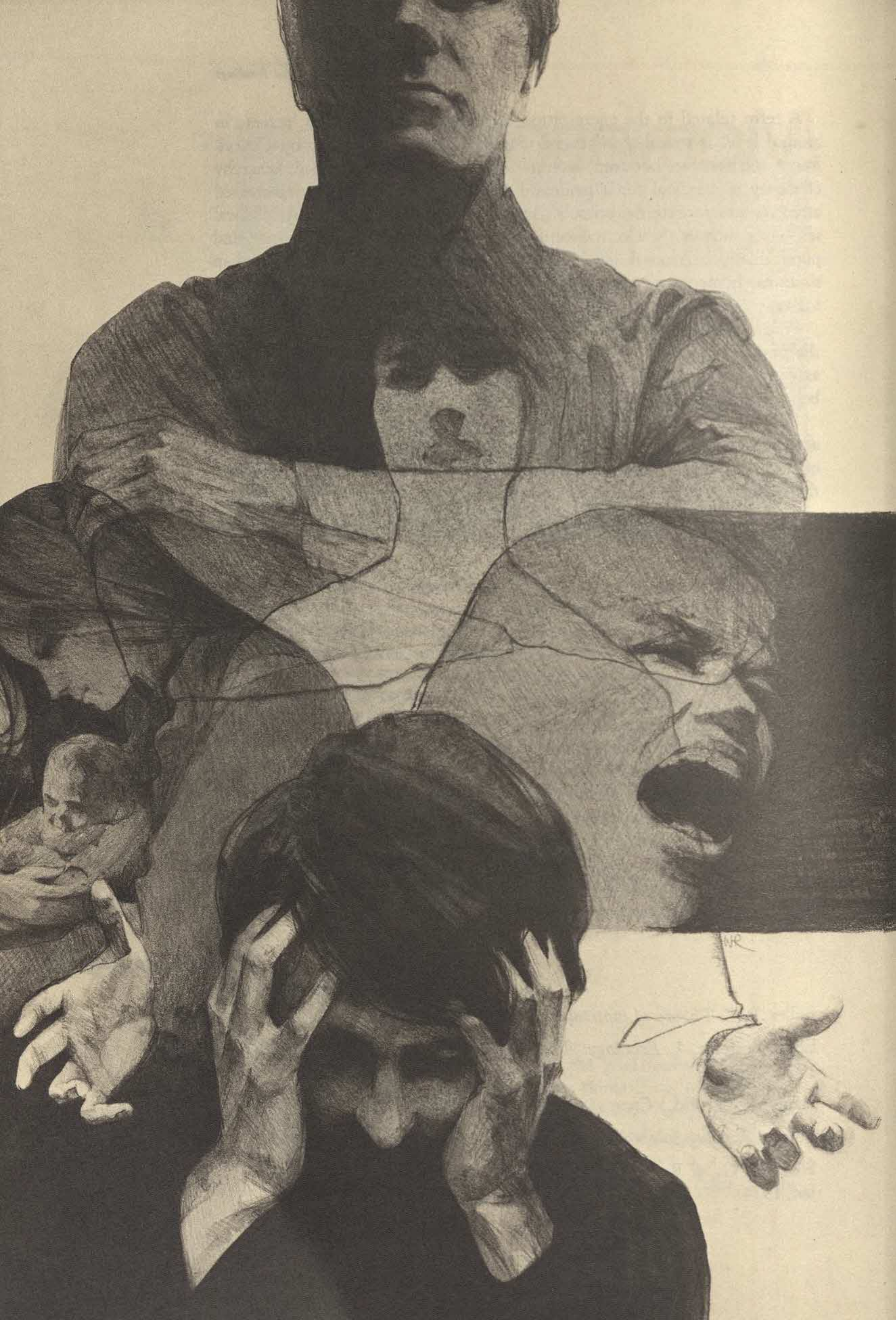


Motivation: Social Motivation

13

In the previous chapter you learned about some motives that operate primarily for maintenance of the individual. In this chapter we shall focus upon motivation for which the behavior is in relation to other organisms. Some socially relevant motivational processes, such as sex and aggression, have important biological determinants, and therefore have some characteristics of primary motives. Other motives such as achievement, affiliation, and power are learned. You will see, however, that learning plays a major role in both kinds of motives discussed here, and a neat separation is not possible. Also you should be aware that much of what will be considered here could just as well be taken up in the last chapter on social psychology, and that the decision as to which topic should appear where is somewhat arbitrary.

First of all, you will see several conceptualizations of social motivation when we consider the question of what framework is the most productive and instructive for understanding this kind of motivation. Next the more biologically relevant motives, including sex, maternal motivation, infant attachment, and aggression will be discussed. Then some problems in assessing social motivation in individuals will be considered, followed by a discussion of some of the research bearing on learned social motives including achievement, affiliation, and power and dominance.

Approaches to Social Motivation

There are a number of ways to approach the problem of explaining social motivation. First of all, in keeping with the ideas presented in the previous chapter, you could view some social motives as secondary motives

learned on the basis of some primary motive, with social goals, such as achievement, serving perhaps as substitutions for more basic primary goals such as hunger or sex. The psychoanalytic approach to motivation, which will be discussed more thoroughly in Chapter 16 on personality, considers that adult social motives owe their existence to, and are ultimately dependent on, basic goals or instincts. Freud, for example, called the basic motive force *libido,* or sexual energy, and motives such as affiliation and achievement were considered as substitutions for this more basic urge.

MURRAY'S LIST

Another view is that social motives should be considered more or less as traits on which individuals may be expected to differ. Henry Murray, a psychologist at Harvard University, suggested in 1938 that man was primarily motivated not by biological motives but by social ones. He compiled a long list of them, similar to the list shown in Table 13.1. He suggested that individuals differ in terms of the extent to which each motive is important and devised a way of measuring individual differences (see below) using one's fantasy production.

MASLOW'S HIERARCHY

Another approach has been taken by the late Abraham Maslow (1970), who was a psychotherapist and one of the founders of the humanistic movement in psychology. Maslow objected to long lists of needs or motives, which he pointed out can be extended *ad infinitum*, depending upon how much detail one wishes to go into. Rather, he felt it was more important to understand how motives are related to each other and how they serve to organize a person's behavior. Maslow suggested that motives are hierarchically arranged, in the sense that some motives are more basic than others. He thought that the more basic motives had to be satisfied before the less basic ones could come into operation.

Physiological needs (e.g., hunger, thirst) are the most basic and must be satisfied before motives further up in the hierarchy can manifest themselves. The next level includes needs for *safety and security*, which are also fairly basic in terms of biological survival. When, however, a person's physiological and safety needs are reasonably well met, then he may begin to develop needs for love and belongingness, i.e., for meaningful relationships with other people. Reasonable satisfaction of these needs, in turn, leads to the development of the need for *esteem*, including self-esteem and the esteem of others. Finally, when these needs are reasonably well satisfied, one develops a need for *self-actualization*, which is the need to develop one's potential to the fullest possible extent and to become what one is best suited to become.

This hierarchical scheme is different from other schemes we have considered. The social needs, when they arise, are *not derived from more basic primary motives*, but, in themselves, function as basic primary motives. Their emergence, however, depends upon the satisfaction of needs at the lower levels. Thus a person cannot develop a strong need for self-actualization without at the same time satisfying his lower-level needs. A person who is chronically hungry is less concerned with safety than one who is well fed.

A List of Human Motives Based Upon Murray's Original List TABLE 13.1

Achievement	*To do one's best, to be successful, to accomplish significant tasks requiring skill and effort, to be a recognized authority, to do a difficult job well.*
Deference	*To get suggestions from others, to find out what others think, to follow instructions and do what is expected, to praise others, to conform to custom.*
Order	*To be neat and orderly, to plan ahead, to organize work, to arrange things so they run smoothly.*
Exhibition	*To say clever and witty things, to be noticed by others, to talk about personal achievements.*
Autonomy	*To be able to come and go as desired, to say what one thinks about things, to be independent of others in making decisions, to avoid conformity.*
Affiliation	*To be loyal to friends, to participate in friendly groups, to share things with friends, to make as many friends as possible.*
Intraception	*To analyze one's motives and feelings, to understand how others feel about problems, to predict and understand others' behavior.*
Succorance	*To have others provide help when in trouble, to seek encouragement from others, to have others be kindly, sympathetic, and affectionate.*
Dominance	*To argue for one's point of view, to be a leader in groups to which one belongs, to persuade, influence, supervise, direct the actions of others.*
Abasement	*To feel guilty when one does something wrong, to accept blame when things do not go right, to feel that personal pain and misery do more good than harm.*
Nurturance	*To help friends when they are in trouble, to treat others with kindness and sympathy, to forgive and do favors for others, to show affection and be a confidant of others.*
Change	*To do new and different things, to travel, to meet new people, to experiment, to try new and different jobs, to participate in new fads and fashion.*
Endurance	*To keep at a job until it is finished, to work hard at a task, to work at a single job before taking on others, to stick at a problem even though it seems no progress is being made.*
Heterosexuality	*To engage in social activities with the opposite sex, to be in love with someone of the opposite sex, to be regarded as physically attractive by those of the opposite sex.*
Aggression	*To attack contrary points of view, to tell others off, to get revenge for insults, to blame others when things go wrong, to read accounts of violence.*

Source: From Edwards Personal Preferance Schedule Manual, 1959.

This view has been influential in some circles, although there is actually little direct evidence bearing upon it. The humanistic movement has taken self-actualization as a goal, and humanistic psychologists are often concerned with the enhancement of self-actualization in individuals.

There is some indication that individuals who are chronically deprived will organize their behavior, their social lives, and their fantasy around the deprivation. For instance, a group of conscientious objectors during World War II volunteered to undergo chronic food deprivation in an experiment. They received a marginal diet for some time. As the study progressed, their behavior became more and more food-oriented; they became jealous of others who they thought received more food at a particular meal; they dreamed of food; and they fantasized a great deal about food-related objects such as cooking utensils. Their social behavior deteriorated as their lives became more food-oriented. Thus, in at least this one case, deprivation at one level seemed to result in the disappearance of higher-level social motivation (Keys et al., 1950).

There are also apparent exceptions to this scheme. For example, there are numerous cases of bravery in combat that seem to contradict the basic notions, and still other cases of individuals (e.g., Michelangelo) who underwent severe physiological hardship in pursuit of some higher goal. What would appear to be needed at the moment are some reasonably good methods for assessing the motivational level of an individual at a given point in time. Then some of these ideas could be subjected to test.

LEARNED RESPONSES

It is also possible more or less to ignore the question of whether motivated behavior reflects particular internal states, or motives, and focus upon the behavior in question. Thus aggression would be considered in terms of a set of learned instrumental behaviors under the control of particular aspects of the stimulus situation; whether or not there is an internal state that causes the behavior is considered irrelevant as long as the aspects of the stimulus situation controlling the behavior can be determined. This view is associated with the work of B. F. Skinner and his followers, and will be considered in more detail in the chapter on personality.

Biologically Based Social Motivation

Sexual Motivation

The biological relevance of sex is beyond question. Like thirst and hunger, it is partly determined by critical substances in the bloodstream, in this case sex hormones, and is partly under control of structures within the limbic system. Sex, however, is not a homeostatic motive in the sense that hunger and thirst are. The intensity of motivation does not seem to increase in any regular way with deprivation.

Sex is also a motive whose manner of instigation differs considerably from species to species. In higher forms such as primates, and, in particular, man, learning plays an exceedingly important role such that it can overshadow the operation of many of the more biologically related processes. We shall discuss both processes in the following sections.

THE NEUROENDOCRINE SYSTEM AND SEXUAL BEHAVIOR

Sex hormones are secreted by the gonads, or sex glands. The testes of the male secrete testosterone, and the ovaries of the female secrete estrogen and

progesterone. Actually, both male and female hormones are present to some extent in both sexes, since both are also secreted by the adrenal gland. The sex glands, however, secrete the major portion of the hormones. The hormones are responsible, through their effect on neural tissue, for the development of sexually appropriate behaviors in lower animals, and also for secondary sexual characteristics such as breasts, distribution of hair over the body, vocal characteristics and distribution of subcutaneous fat.

Sex hormones are also responsible for the development of glands that secrete musk and similar substances that serve as attractants for members of the opposite sex. Chemical communication through odorous substances is quite important in sexual behavior, even in humans. The chemicals, along with others not involved in sexual behavior, are called *pheromones*. Pheromones, in turn, function as releasers (Chapter 12) for instinctive behavior. Not only is the secretion of these substances under hormonal control, receptivity to the odors is also. For example, human males secrete a musklike substance that can be sensed by females who have passed the age of puberty but who have not yet gone through menopause, i.e., females whose ovaries are secreting estrogen. Males are insensitive to this substance, unless they are first given estrogen, in which case they can detect it (Eibl-Eibesfeldt, 1970).

If a male is castrated before puberty, his sexual activity will be considerably reduced if not eliminated. Postpubertal castration will have varied effects, depending upon prior learning of sexual behaviors, and also upon the animal. Lower animals such as the rat are much more likely to be permanently altered than man. Even in man, however, the sex drive is markedly lowered by castration so that it can hardly be said that the hormone level has a negligible effect. All of the effects of castration may be ameliorated by injections of testosterone in both rats and man as well as in other species.

Removal of the ovaries in the female will likewise abolish sexual behavior in most animals. The female rat, for instance, goes into heat every 4 days or so, and ovariectomy will abolish this cycle. Since males are accepted only during estrus, the effect of the operation on sexual behavior is drastic. Humans and some other primates, on the other hand, do not have such precisely defined periods of receptivity, and removal of the ovaries has less of an effect upon their behavior. Some human females, for instance, may be motivated to have intercourse at any time during the menstrual cycle, although hormonal levels vary considerably over the cycle. Furthermore, it is reported from various sources that women can continue to have sexual intercourse up to age 70 or 80, way beyond the menopausal time when the ovaries degenerate (see pp. 364–366).

Various areas in the central nervous system influence sexual behavior, and many of them are located within the limbic system, especially in the hypothalamus. These areas seem to be particularly sensitive to sex hormones, in that very minute quantities injected into the areas will, especially in the female, produce long-lasting increases in sexual activity. Thus sex hormones seem to function in much the same way as neural transmitters (Chapter 4). Electrical stimulation of these areas will also evoke either the whole pattern

Human Sexuality

There are few aspects of human behavior more affected by misconceptions than that of sexuality. This is partly because of the strong impact that religious beliefs have had on our understanding of sexual motivation, and partly because, until recently, there has been little in the way of scientific investigation of human sexual behavior. The literature in biology and psychology abounds with experimental and naturalistic studies of animal sexual behavior, and there are a few works on the sexual behavior of primitive people. However, until 1948, when Kinsey, Pomeroy, and Martin published their normative study, Sexual Behavior in the Human Male *and later (Kinsey, Pomeroy, Martin, & Gebhard, 1953)* Sexual Behavior in the Human Female, *practically all we knew about the behavior of middle-class Americans was based upon popular stereotypes. Kinsey's reports indicated a considerably wider range and extent of sexual behavior than might have been thought previously. That is, the variety of practices, and extent of norm-violating behavior (e.g., premarital and extramarital sex) were reported as being surprisingly high.*

Even more recently, the behavioral and physiological aspects of sexual intercourse have been directly studied by Masters and Johnson, who observed couples engaging in sexual intercourse in a laboratory setting, and reported their findings in a book, Human Sexual Response *(1966). Their work has led to the development of therapeutic programs designed to help individuals achieve more adequate sexual behavior. In addition, the development of factual information about sexual intercourse has added considerably to our basic understanding of the phenomenon. A very readable summary of this literature has been written by McCary (1967), which is the basis for this discussion.*

One popular myth that has been exploded concerns the relative intensity of the sex drive in males and females. For some time it was thought that females were basically less highly motivated sexually than males. This myth probably relates to the more stringent restrictions on premarital sexual behavior imposed on females in this culture, but it certainly has no biological basis. Cross-cultural studies have shown, for example, that females are quite responsive sexually in cultures in which their sexuality is encouraged. The studies of American males and females also tend to explode the myth, although it is hard to disentangle the findings from the effects of repressive early training. The Kinsey Report does indicate differences between males and females, particularly in terms of the ages at which sexual motivation is strongest. In males the drive is strongest between the late teens and age 25, whereas in females the peak is reached between 31 and 40. This arrangement, of course, may be quite inconvenient for highly motivated females married to slightly older men.

Kinsey's work differentiates several means of achieving sexual gratification in addition to heterosexual intercourse and petting: masturbation, nocturnal orgasm (i.e., dreams in which orgasm is experienced), homosexual behavior, and bestiality (sexual contact with animals). Each of these provided an outlet for a significant number of individuals, both female and male, although the incidence of females having sexual contact with animals was quite low. Masturbation was reported by 95 percent of the males interviewed, and different samples have indicated the figure for females as 50 to 80 percent. The incidence in males declines with age past the teens but increases for females, in keeping with the previously mentioned changes in sexual motivation with age.

Almost all of the individuals, male and female, reported petting at least some of the time, and in a significant number of both sexes it was frequently used as a means to orgasm, particularly in college-educated adults.

The incidence of homosexuality reported by Kinsey was perhaps surprising, with 37 percent of the males interviewed reporting at least some homosexual experience. The figure was less for females, with only 13 percent reporting homosexual behavior. The incidence of bestiality was also quite high, at least among males, with 40 to 50 percent of the farm boys included in the sample reporting sexual contact with animals.

Premarital heterosexual intercourse was also reported by a relatively large number of the individuals interviewed: 98 percent of the males who had not gone to high school and about 50 percent of the females. The figures were somewhat lower for more educated males, 84 percent for those with high school educations and 67 percent for college-educated males.

By and large, most of the sexual activity reported was heterosexual, between married adults, which is what one would expect. It was also found that contrary to popular belief, old age does not necessarily render males or females incapable of having satisfactory sexual intercourse. For example, at age 60 Kinsey reported that 94 percent of males and 84 percent of females were still having sexual intercourse. Although further aging reveals a somewhat lower incidence, the data show that there are few if any intrinsic reasons why sex cannot be enjoyed beyond age 70 or more. Perhaps one of the reasons why older people show less interest in sex is that they think they are supposed to.

The research reviewed by McCary also puts to rest another misconception —that concerning the female's orgasmic response. For a long time it was thought that most females were incapable of achieving orgasm. However, research, particularly that of Masters and Johnson, has indicated quite clearly that most females are physiologically capable of orgasm, although the amount and nature of stimulation necessary varies from person to person. Indeed, some women are able to have more than one orgasm during a single experience. This is in contrast with males, except perhaps younger ones, who go through a refractory period following orgasm during which arousal is quite difficult, if not impossible, to attain.

These findings seem to indicate that human beings are highly sexual creatures, but that there are considerable individual differences in the degree of sexual motivation. The reports are replete with indications of the extreme range of variation between individuals. At this point there is no really good explanation for these individual differences.

of sexual behavior or some of its components. For example, one rat, stimulated in the hypothalamus 5 minutes on and 5 minutes off during a 7.5 hour period, was observed to mount a female 155 times, on 81 of which intromission (insertion of the penis into the vagina) occurred; ejaculation occurred on 45 of the times (Vaughan & Fisher, 1962).

Other areas of the brain are also important for sexual behavior, since the appropriate mate must be identified, and proper execution of the sexual act requires some degree of skill, particularly for the male.

THE ROLE OF LEARNING IN SEXUAL BEHAVIOR

As should be clear by now, learning is more important in higher than in lower animals. However, at least among the mammals, there does not seem to be any animal whose sexual behavior is not at least partly dependent upon learning.

The rat's sexual behavior is often cited as an example of innate determination, since the behavior appears at maturity, and is appropriately directed and executed at the first opportunity. However, several experiments (e.g., Gerall, Ward, & Gerall, 1967) have found that rats reared in isolation do not mate appropriately. Isolated males, for instance, when placed with a receptive female, became quite excited and jumped about but were unable to mate effectively. Social isolation also produces severe disturbances in the sexual behavior of monkeys, according to Harlow (1962). Other studies with primates have shown that a great deal of learning must take place before effective sexual behavior can occur. For example, male and female chimpanzees were reared together as infants and preadolescents but separated before puberty. After puberty, when the sexes were again mixed, none of the animals showed effective sexual behavior, although the males were quite interested in the females and vice versa (Nissen, 1953). In the case of chimpanzees, effective sexual behavior must be learned from an adult.

Maternal and Infant Behavior

Quite remarkably, many animals whose offspring require care before being able to fend for themselves exhibit completely adequate parental behavior on the first occasion, without the opportunity for any prior learning to have taken place. Also, the offspring often exhibit a reciprocal attachment to the parent, which is either unlearned or acquired quite rapidly. These behaviors are significant biologically, since they insure propagation of the species through the production of viable offspring. However, the literature on this

topic is extensive and detailed, and there are many rather specific differences between species so that only a smattering of what is available can be dealt with here. As in the case of sexual behavior, neural, hormonal, and learning factors are involved.

NEURAL AND HORMONAL FACTORS

While maternal behavior (including, when appropriate, the paternal behavior of the father) in birds and lower mammals such as the rat appears to be quite complex, it is actually under the control of sex hormones in what seems to be a rather simple fashion (Figure 13.1). Nest-building, for instance, is a rather complex affair involving a sufficient amount of skill in architecture, engineering, and environmental physiology to provide a sturdy

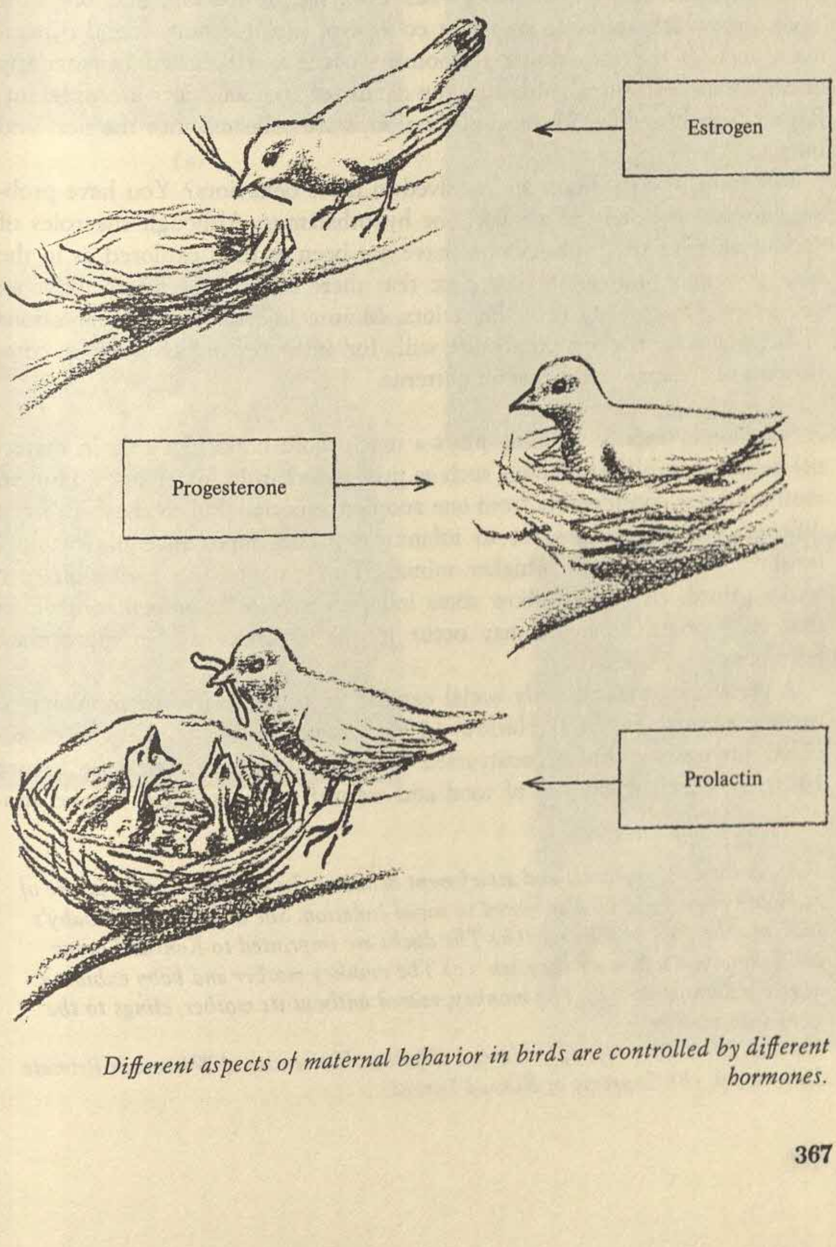


FIGURE 13.1

Different aspects of maternal behavior in birds are controlled by different hormones.

structure that will accommodate the brood and provide some degree of warmth and protection. This complex behavior, however, can be induced in isolated ring doves simply by injecting estrogen into the animal once a day for a week (Lehrman, 1958). The behavior cannot be considered as intelligent, since some injected birds would build a nest on top of another nest that already contained eggs. Injecting progesterone, on the other hand, will induce the animal to incubate any eggs that are presented to it. Another hormone, prolactin, which is secreted by the pituitary gland, affects a third aspect of maternal behavior, brooding and feeding the young. (The same hormone in mammals induces the secretion of milk in the mammary glands.) Prolactin will even induce maternal brooding in the cock, who would ordinarily either ignore or attack baby chicks. Thus the picture is that of three rather involved sets of behaviors—nest-building, incubation, and brooding—each of which seems to be under control of a single hormone. In mammals, such as the rat, similar phenomena occur and seem to be similarly under hormonal control, although the details of the behaviors are different. Rather than brooding, for example, rat pups are collected into the nest and nursed.

What areas of the brain are involved in these behaviors? You have probably already guessed the answer: the hypothalamus. Although the roles of various areas of the hypothalamus have not been as fully explored as in the case of hunger and thirst, it is clear that there are centers which exert an important influence on these behaviors. Minute injections or implantations of hormones in the hypothalamus will, for instance, induce various components of the maternal behavior patterns.

LEARNING FACTORS IN MATERNAL BEHAVIOR

As you might expect, learning plays a much more important role in maternal behavior in higher animals such as primates than in lower ones. Human mothers differ considerably from one another, especially when they are from different cultures, in respect to infant care. The importance of learning, however, is not limited to higher animals. For example, rats giving birth to second, third, etc., litters show some independence of hormonal control, in that appropriate behavior may occur in the absence of the appropriate hormones.

A certain amount of early social experience is necessary for monkeys to become normal mothers. Harlow (1962) reared baby monkeys with so-called surrogate mothers constructed of wire or of terrycloth (see Figure 13.2). A sufficient amount of food and warmth was provided, but no con-

FIGURE 13.2 *Various forms of maternal and attachment behavior. In (a), the mother is one of Harlow's monkeys who was reared in social isolation. She is pressing her baby's face into the floor of the cage. (b) The ducks are imprinted to Konrad Lorenz and follow him wherever they can. (c) The monkey mother and baby exhibit a normal relationship. (d) The monkey, reared without its mother, clings to the terrycloth mother.*

Harlow, 1962. (a), (c), (d), Harry F. Harlow, University of Wisconsin Primate Laboratory. (b) Courtesy of Konrad Lorenz.

(*a*)

(*b*)

(*c*)

(*d*)

tact with other monkeys was available. These monkeys, when they became adults, were quite abnormal in many ways, particularly in regard to sexual and maternal behavior. As Harlow put it, a few valiant, highly experienced and insistent males were able to impregnate some of the female isolated monkeys, who subsequently gave birth to infants. The maternal behavior of these mothers left much to be desired. Some were quite cruel to their children, grinding their faces into the floor, and resisting their highly persistent attempts to cling to them. While some of this abnormal behavior disappeared with the second pregnancy, the study clearly illustrates the importance of adequate social stimulation for normal maternal behavior in the monkey.

ATTACHMENT BEHAVIOR OF INFANTS

Parental behavior, in order to be effective, requires some reciprocity on the part of the infant. This is especially true if the young develop precociously, i.e., are able to get around at a very early age. Baby ducks, for example, as well as other birds and some mammals, go through a stage early in their development in which *imprinting* occurs. During a critical period after birth the infant will become "attached" to whatever stimulus object is moving in its visual field. Thereafter, that object is responded to as "mother." It will follow it, run to it for protection, and in later life, may even attempt to mate with it. Fortunately, in most cases the object to which the infant becomes imprinted is a member of the same species. However, it may also be a human or even an inanimate object. (A colleague of the author who was studying imprinting in ducks had several of them who were imprinted to his Volkswagen.) The relevance of this very rapid kind of learning to an understanding of motivation is that the object of the imprinting becomes a prominent goal in the animal's behavior, and, in most cases the goal is a biologically appropriate one. It is as though the animal is "wired" to undergo this very special kind of learning at a critical time—an innate predisposition that has clear biological significance.

Newborn or very young infants exhibit other forms of motivation related to attachment. You might think of hunger as an obvious one, although its relationship to attachment has actually turned out to be quite tenuous. Much more important is the need for warmth and contact comfort. Harlow's study of infant monkeys reared with surrogate mothers illustrates this point quite well. Some of the subjects had access to two surrogates, one of which was constructed of wire and provided milk from a bottle. The other was made of terry-cloth and was warmed by a light bulb inside but provided no milk. The babies, when given the choice, would cling to the terry-cloth mother until they become quite hungry, at which time they would go to the wire mother for milk but would only eat and run. In other words, even though the wire mother satisfied the hunger motive, she was quite unsatisfactory in other respects, and the soft, warm mother was much preferred. The need for contact comfort, then, seems to be just as primary and unlearned as hunger.

You have already seen that the development of smiling in response to a human face occurs during the first year of life (Chapter 6; see also Chapter 14). This response, of course, is another important component of the

infant's attachment behavior, since it appears to establish a social bond between the infant and whoever is tending it.

Aggression

Without a doubt, aggression is one of the most controversial topics within psychology. It is also one of the most important, at least from the point of view of social relevance. People kill, maim, and otherwise harm one another at a tremendous rate, and social theorists, jurists, lawyers, psychiatrists, ministers, educators, and parents observe, pronounce, legislate, admonish, analyze, counteraggress (punish), and wring their hands at almost the same rate. Actually, very little has been accomplished to make aggression any less of a problem, in spite of the tremendous interest it has generated in the past few years. We can, however, examine the phenomenon and attempt to understand it as one form of motivated behavior. We shall, very briefly, deal with its origins in the biological makeup and early social experience of the animal, and some of its later manifestations.

FRUSTRATION AND AGGRESSION

One early attempt to explain aggression in psychological terms was made by Dollard et al. (1939), who published a book entitled *Frustration and Aggression*. In it they advanced the *frustration-aggression hypothesis*, according to which the *only* cause of aggression was thought to be the frustration of motives. While frustration is certainly one cause of aggression, it is clearly not the only cause, as the work of the ethologists has pointed out. Aggression is also the result of specific stimuli which, through innate releasing mechanisms, trigger aggressive behavior. As you will see in the following discussion, aggression can also be viewed as a learned instrumental response to particular stimulus situations, with no implication of frustration as its cause. Thus the frustration-aggression hypothesis is at the moment of only limited value in explaining aggression.

BIOLOGY OF AGGRESSIVENESS

In some respects it would be appropriate to speak of aggressiveness as a primary motive, since it seems in some species to be rather closely tied in with biological processes. For example, aggression is more likely to occur in male than in female animals. Females of many species rarely fight, except when protecting their young. Males, however, may fight among themselves under various circumstances. Numerous studies have shown that aggressiveness is affected in an important way by the male hormone testosterone. The aggressiveness of both males and females may be increased by administering doses of testosterone, and castration of males reduces aggressiveness to a very low level in most species.

The amount of the hormone present at an early age seems to be an important factor in determining later aggressiveness. In one experiment female rats were administered one dose of testosterone at birth. Later at 60 days of age they were tested in a competitive fighting situation, having been injected once again with testosterone before fighting. When compared with control females that had not been injected at birth and with normal males (both comparison groups having been injected prior to fighting), the pre-

injected females fought as much as the males, whereas the normal females fought not at all (Edwards, 1968).

Recent work with humans has also linked aggressiveness with the male hormone. There is some evidence, discussed previously on p. 60, that some males with an extra Y chromosome are both hyperaggressive and show increased amounts of male hormone in their blood.

With regard to the general level of aggressiveness in humans, it would make sense biologically that humans would exhibit a fairly high amount of this trait. This point has been argued by such writers as Robert Ardrey (*The Territorial Imperative*), and Konrad Lorenz (*On Aggression*), to mention only two. They argue that man evolved as a hunter, and aggressiveness was required for survival. He also evolved as a group-oriented, territorial creature; and the survival of the group, including the family, depended upon aggressiveness toward outsiders. This basic aggressiveness is still with us, these writers argue, and manifests itself in various ways, many of which result in mayhem. Successful efforts to control the more destructive aspects of aggressiveness must, it would appear, begin with a recognition of these facts.

Aggressiveness in lower animals does not usually result in mayhem. The reason for this seems to be that these animals have evolved certain rather specific forms of expression of aggressive intent (threat gestures), as well as behaviors that indicate submissiveness on the part of a weaker animal. Rather stable dominance hierarchies are established which, when the appropriate submissive behaviors are employed, tend to decrease the amount of fighting. The submissive postures have the effect of inhibiting the aggressiveness of a threatening animal. A subordinate monkey, for instance, may assume the female sexual posture in the face of a threat by a dominant male. Subordinate dogs and rats will roll over and bare their underbellies as a gesture of submission. Thus, in these species, the manner of expression of motive to aggress is fairly well "worked out" so as to minimize physical danger to the individuals involved.

Are there such behaviors in humans that serve the same function? The ethologist Tinbergen (1968) suggests that we have such behaviors, and that they are species-specific. Frowns, grimaces, and other facial expressions are signals of anger, and smiles can be appeasement gestures. These behaviors work within a given group but do not work between groups; hence there is no biologically effective way to avoid wars and other forms of intergroup fighting. Such methods, if they are to come about at all, must come as a result of man's cognitive and rational abilities, not his biologically determined methods for handling aggressive motivation.

Erich Fromm (1973), a psychotherapist, has recently argued that running away from a dangerous situation is just as basic a biological response as is fighting. (In discussions of the operation of the sympathetic nervous system, it is usually said that sympathetic activity prepares the animal for fight *or flight.*) He wonders why the impulse to flee is not given as much attention as the impulse to fight, and suggests that the emphasis is a product of political and cultural ideology. He argues that viewing man as a naturally

destructive and cruel creature is the best way to rationalize modern society's "almost limitless readiness for destruction of human lives for political and economic ends (p. 45)."

Thus he would argue that man's "cognitive and rational abilities" have painted a biased picture of man's aggressiveness. Like Tinbergen, however, he sees the solution to the problem to be in a rational approach, deemphasizing the explanation of aggressiveness as the only way to deal with a threatening situation.

Anthropological data tend to support the idea that the handling of aggression is a culturally determined phenomenon. Among "primitive" people there are aggressive societies and there are societies in which aggressiveness is almost unheard of. The Arapesh of New Guinea, for example, are extremely unaggressive, and rarely if ever fight, even when attacked by outsiders. These people tend not to idealize masculine ideals and do not admonish their young males to adopt rigidly defined male behaviors, a factor that may partly account for their peaceableness.

Perhaps the best way to deal with the question of the origins of aggression is to accept the idea that there are probably biological predispositions toward both aggressiveness and running away which are, however, highly subject to modification through certain kinds of learning. It is to the latter point that we now turn.

THE LEARNING OF AGGRESSIVENESS

Previous experience has been shown to play a significant role in aggressiveness in several different species. Mice, for example, when paired in a competitive fighting situation with more aggressive partners, will temporarily become less aggressive, and vice versa (Lagerspetz, 1961). Other studies have shown that animals will exhibit aggressive behavior when to do so results in reward. Pigeons, for example, when rewarded with food for attacking another pigeon, would increase their frequency of attacks on the unfortunate target. The attacks, however, ceased when the food reward was withdrawn (Azrin & Hutchinson, 1967).

Human children also will alter their aggressive behavior in response to reinforcements. Children who were rewarded for attacking a Bobo doll increased the frequency and intensity of their attacks in much the same manner as did Azrin and Hutchinson's pigeons described earlier (Bandura & Walters, 1963).

You may wonder whether aggressive behavior that is shaped through operant conditioning is really a reflection of aggressive motivation, or whether it is simply one of many possible instrumental responses that might be learned in the service of some other motive such as the need for approval or (in the case of the pigeons) food. The question is difficult to answer since a motive can only be inferred from behavior. There are, however, other ways of getting at the question, one of which is through studies of home environments of children differing in the aggressiveness of their behavior. Wiggins, Renner, Clore, and Rose (1971) describe a number of studies attempting to relate aggressiveness to parental attitudes and behavior. Although there are some inconsistencies, it would appear that

boys whose mothers are dominant in the family are less aggressive than boys whose fathers are dominant. The reason is probably that most mothers tend to discourage overt aggression, and fathers to encourage it. Boys whose mothers actively encouraged aggression were more likely to be aggressive, even if the mothers were dominant. Thus once again we see that aggressive behavior, when rewarded, will increase.

There is also evidence that aggressiveness is more likely to occur when the potential aggressor is more or less anonymous. Zimbardo (1970) reports a study in which coeds were induced to administer electrical shock to another "student," who was presumably participating in an experiment on conditioning. Half of the girls were anonymous. They wore hoods and laboratory coats; their names were never used; and none of the subjects knew the others. The other girls wore name tags, were called by name, and knew the other subjects with whom they were tested. The "subject" whom they were supposedly punishing with shock was presented in a taped interview as either a nice, pleasant person or an obnoxious, self-centered, conceited person.

Each girl administered 20 shocks to the "learner" in the conditioning "experiment," and the duration of each shock was measured. The results indicated that the anonymous subjects administered longer shocks to the "learner" than did the subjects who were indentifiable. Furthermore, the anonymous subjects increased the duration of their shocks over the 20 trials for both the nice and the obnoxious "learner," while the identifiable girls, who shocked both nice and obnoxious subjects at a lower level, actually decreased their shocks to the nice subject over the 20 trials. Thus anonymity not only seemed to affect the amount of hurt done to the "learner" but also whether or not the subjects were sensitive to potentially ameloriating aspects of the "learner's" personality.

Violence and Television. A currently important related issue—one on which there has been much debate—concerns the role that imitation plays in aggressiveness. The debate has centered around the effect upon aggressive behavior of violence as depicted on television and in the movies. One position is that viewing violent acts, particularly those that go unpunished, may lead to imitation of such behavior on the part of children and, ergo, increased violence. The other position is that viewing violence has a cathartic effect, permitting the "release" of aggressive dispositions but without harming others. A number of experiments have indicated that the first view is correct, that viewing violence increases one's tendency to be violent.

One such experiment is somewhat complicated but instructive. The idea was first to arrange for one individual (a confederate of the experimenter) to behave in such a way that he frustrated a second person (the subject). Then the subject was shown a section of a movie in which the hero (Kirk Douglas, in *The Champion*) was severely beaten in a boxing match. Douglas was described to half of the subjects as a scoundrel, whose beating was justified; to the other subjects he was described as having been victimized. The critical phase of the experiment occurred when the frustrated subject

Down Deep, People are not necessarily the Same

It is common knowledge that different cities have different "atmospheres," which pertain to how people behave toward one another. Some places are known as "friendly," others as "snobbish," etc. Some cities have high crime rates, while citizens of other cities seem to be more law-abiding. This difference was dramatized several years ago by Zimbardo and Fraser (Zimbardo, 1969) in the following way.

Simultaneously, two cars were left on the street of a city, the license plates removed and hoods raised. One of them was left in the Bronx, New York, and the other was left on a street in Palo Alto, California. They were watched continuously for 64 hours. What do you suppose happened?

First the New York car: Within 10 minutes a family consisting of husband, wife, and son arrived on the scene. While the wife watched and the son handed him the tools, the father removed the battery and radiator. Twenty-six hours later additional parts had been removed, including the air cleaner, antenna, windshield wipers, chrome, hubcaps, battery cables, a gas can, car wax, and a tire. Then, after 35 hours children from teenage downward began to destroy what was left. According to Zimbardo,

"In less than three days what remained was a battered, useless hulk of metal, the result of 23 incidents of destructive contact. The vandalism was almost always observed by one or more other passersby, who occasionally stopped to chat with the looters. Most of the destruction was done in the daylight hours . . . The adults were all well-dressed, clean cut whites who would under other circumstances be mistaken for mature, responsible citizens demanding more law and order. (pp. 289–290)."

The car left on the street in Palo Alto was unharmed, and one passerby even lowered the hood when it began to rain.

Zimbardo suggests that the difference in outcome is to be found in the interaction between the "releaser" cues (i.e., stimuli that "release" a given behavior, in this case aggression) and the feelings of anonymity resulting from life in the two different cities. With anonymity, he argues, fewer cues are necessary to release the violence.

The violence could be released even in California, however, but it was necessary to provide stronger cues than simply the car, no license plates, and the hood up. Moving the car to the Stanford University campus, the authors began to attack it with a sledge hammer. Soon students, initially reluctant to attack the car, moved in with great gusto, and before long it was demolished.

was given the opportunity to shock the confederate who had frustrated him. The shocks were presumably to indicate the subject's judgment of a drawing said to have been produced by the confederate. The outcome was that those subjects who had seen the "justified" aggression in the movie delivered more and longer shocks than those who were led to believe that the aggression was unjustified. (No one was actually shocked. The subject only thought he was shocking the confederate.) The point is that viewing aggression can, under the proper circumstances, result in increased aggressiveness on the part of the viewer (Berkowitz, 1964).

It has been argued, however, that the single exposure to aggressive content is not adequate to assess the overall effect of a more continuous "diet" of televised aggressiveness. Feshback (1970) summarizes several research studies conducted by himself and his colleagues in which boys were subjected to weeks of a prescribed diet of either violent or nonviolent television programs. In this study it was found that boys were actually reduced in aggressiveness when they watched the aggressive programs. This effect was not found in the boys who watched the control, nonaggressive programs. In other words, the question of the effect of televised violence remains open.

Assessment of Social Motivation

THROUGH FANTASY

When Murray proposed his original list of motives, he also made the point that most of them operated unconsciously. That is, most individuals would not be aware of how much of each motive they had. The only way to assess motivational levels, he argued, was through the analysis of one's fantasy productions, in which unconscious processes might be expected to manifest themselves. Murray devised a test of fantasy, the Thematic Apperception Test (TAT) for this purpose. It consists of a set of cards depicting various scenes, in most of which are people in rather ambiguous situations. One card is illustrated in Figure 13.3. The cards are given to the subject one by one, and he is instructed to make up a story about each of them. He is to indicate what is happening in the picture, what led up to it, and how the outcome will be. It is assumed that the central character in the story will mirror the subject himself in terms of his motives. (In other words, the subject *projects* his motives onto the central character. For this reason this kind of test is often called a *projective* test.) Each story is then analyzed for content that is indicative of particular motives. For example, a subject's stories may be full of instances in which a person starts at the bottom, overcomes all obstacles, and achieves success in the end. Such a person would have a high score on achievement motivation. Another person may tell stories in which one character is dominated by another one in such a way that he has no autonomy. The need for dominance and/or autonomy would be indicated here.

There are other ways of analyzing fantasy. McClelland (1961) has examined writings and artistic productions by people in earlier ages and

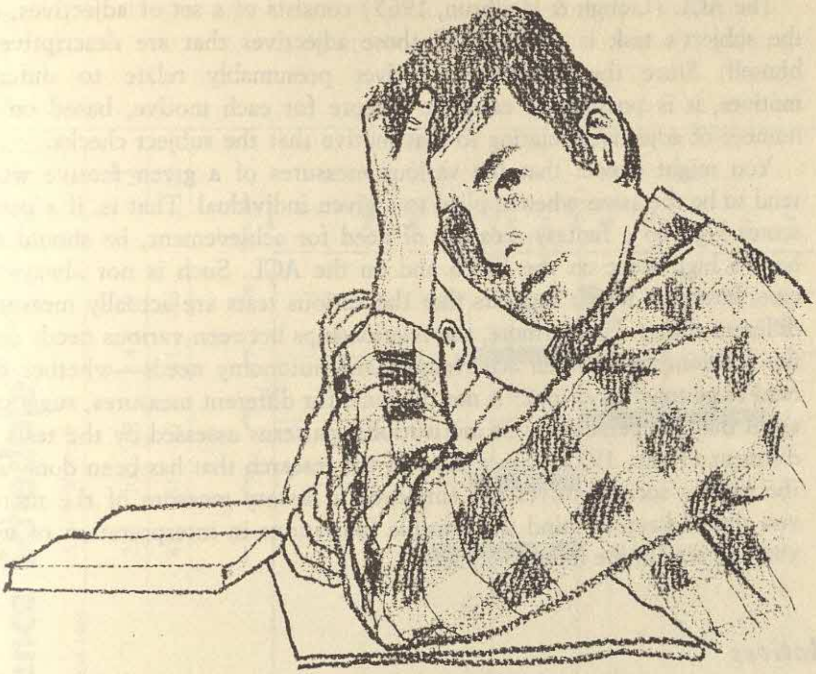


FIGURE 13.3
A stimulus card like those used to assess motivation.

has suggested that motivational content may be determined in much the same way as in analysis of TAT stories. He has examined, for example, achievement imagery expressed in children's readers, in folk literature and music, and even in graphic art, and argues that the overall level of a particular motive in a society may be assessed in this way.

PAPER-AND-PENCIL TESTS

Paper and pencil tests, in contrast with individual tests such as the TAT, which require much time on the part of the examiner in order to obtain scores by analyzing stories, are advantageous in that large numbers of individuals may take them at once, and they may often be scored by means of a key. However, as proponents of projective testing point out, they are limited to conscious verbal reporting. If you believe that projective tests "tap" unconscious processes, then paper and pencil tests would be of only limited value. Several paper-and-pencil tests have been developed to permit the assessment of motivational level, including the Edwards Personal Preference Schedule (EPPS), and the Adjective Check List (ACL).

In the EPPS (Edwards, 1959) the subject is presented with pairs of statements with the instructions to indicate which one of each pair is more characteristic of himself. For example, one pair is: (a) "I like to talk about myself to others," *versus* (b) "I like to work toward some goal that I have set for myself." Each item in a pair reflects one of 15 needs based on Murray's list, and each need is represented by 14 items. Thus each need can be matched with every other need for a total of 210 pairs. The result is a score on each of the 15 needs, as indicated in Figure 13.4.

The ACL (Gough & Heilbrun, 1965) consists of a set of adjectives, and the subject's task is to check all those adjectives that are descriptive of himself. Since the different adjectives presumably relate to different motives, it is possible to calculate a score for each motive, based on the number of adjectives relating to that motive that the subject checks.

You might expect that the various measures of a given motive would tend to be the same when applied to a given individual. That is, if a person scores high on a fantasy measure of need for achievement, he should also have a high score on the EPPS and on the ACL. Such is not always the case, however, which suggests that the various tests are actually measuring different things. Furthermore, the relationships between various needs (e.g., the relationship between achievement and autonomy needs—whether they tend to go together or not) is not the same for different measures, suggesting again that the personality or motivational patterns assessed by the tests are different (Fiske, 1973). Since most of the research that has been done with the various social motives has employed a fantasy measure of the motive, you should keep in mind the possible limitations in interpretation of what you will read in the following pages.

Learned Social Motives

Achievement Motivation

Without a doubt the achievement motive has been more extensively studied than any other motive, except perhaps aggression. Much of the aggression research, however, involves lower animals, so, as far as human motivation is concerned, we know more about achievement than any of the others.

The achievement motive is inferred in individuals who are concerned with attaining goals in the face of adversity or competition. The focus is upon doing a job efficiently and in accordance with high standards. However, not just any job will do in satisfying the achievement motive. There must also be some chance of failure. That is, one has not achieved anything if there was not a chance that he might fail.

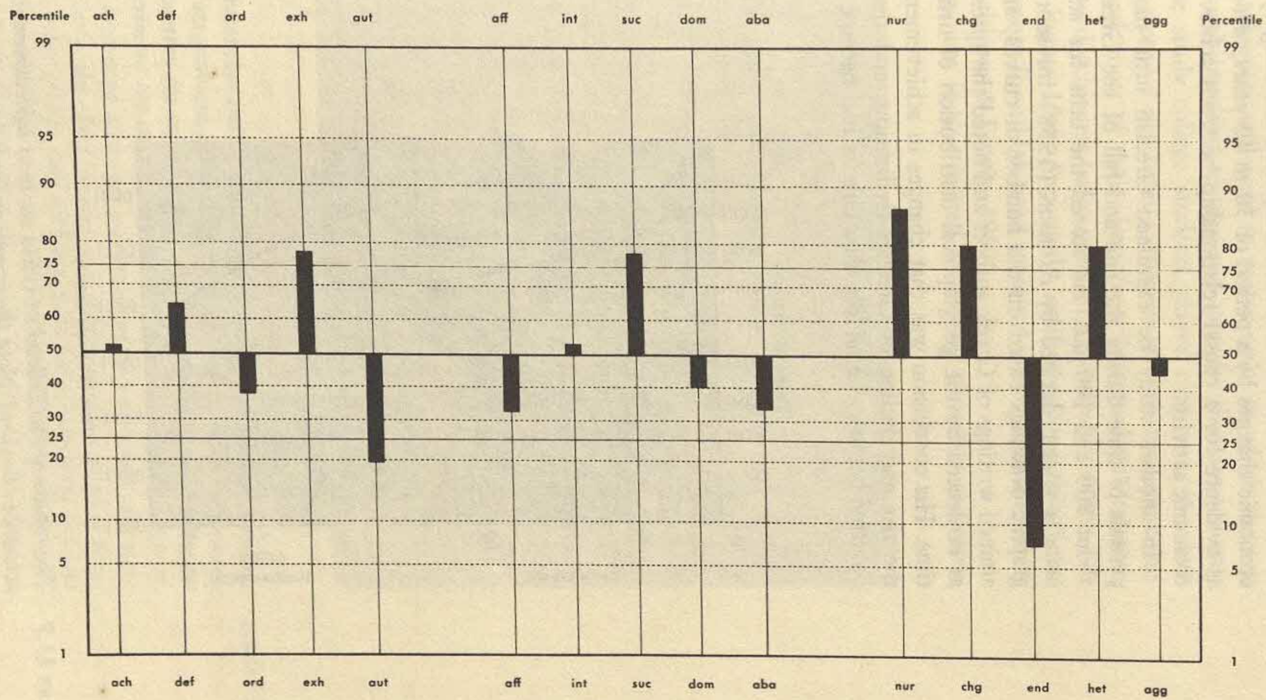
David McClelland, in his book *The Achieving Society* (1961), has argued that the need for achievement is the *sine qua non* of a high level of economic development in a society. He has marshaled a great deal of indirect evidence to support his position. For example, he considered the economic status of England between the years 1500 and 1830, as evidenced by the amount of coal imported. This seems like a relatively good index of economic standing for an industrial nation like England, since coal was necessary for much of the industrial activity. As a measure of achievement motivation he

FIGURE 13.4 *A sample profile obtained with the Edwards Personal Preference Schedule. The central line at the 50th percentile represents an average score. The length of each bar above or below the 50th percentile line indicates the extent to which that individual's score is above or below average.*
From "Edwards Personal Preference Schedule Manual." Reproduced by permission 1954, 1959.

Edwards Personal Preference Schedule

NAME ____________ (LAST) ____________ (FIRST) SEX F NORMS USED Adult–Women

	ach	def	ord	exh	aut	aff	int	suc	dom	aba	nur	chg	end	het	agg	con
Raw Score	13	16	14	14	8	16	15	16	8	15	23	20	9	14	9	14
Percentile	50	66	38	78	20	35	52	78	40	36	87	81	7	81	46	97



FOLD HERE TO TRANSFER SCORES

examined literary material such as ballads, drama, accounts of voyages, etc., counting the number of achievement images per 100 lines. The results of this study are shown in Figure 13.5. As you can see, there is a striking parallel between the two measures. Where achievement imagery went up, economic activity went up also; where imagery went down, economic activity went down. It is noteworthy that the imagery changes preceded the economic changes by a period of 30 to 50 years, which one might interpret as evidence for a causal relationship between achievement motivation and economic activity.

In another study he examined Grecian urns manufactured at various periods of time during the rise and fall of the Greek civilization between about 900 and 100 B.C. He scored the urns for achievement motivation, using a system devised by Aronson (1958) for scoring doodles and other graphic drawings based on the number of curves, angles, etc. He also examined writings of Greek authors and noted the spread of Grecian influence as evidenced by the geographical distribution of urns at various points in time. His conclusion was that changes in achievement motivation presaged the rise and decline of Grecian civilization, and that the decline perhaps occurred because the middle class Greeks had become entrepreneurs wealthy

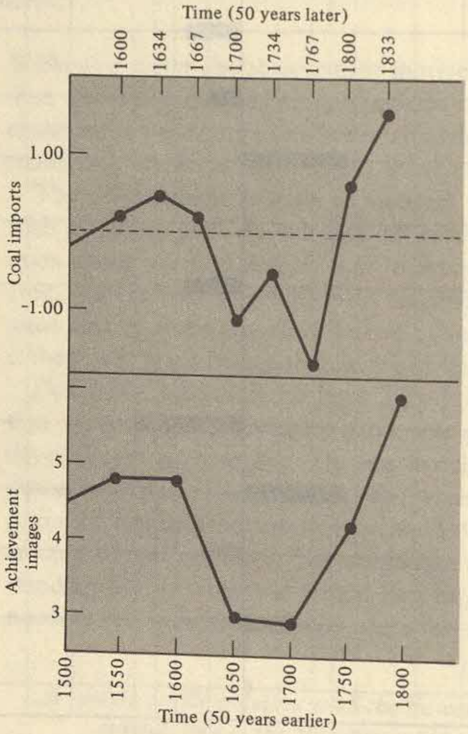


FIGURE 13.5 *The results of McClelland's (1961) study of achievement imagery and economic activity in England. Note the correspondence between changes in achievement imagery and changes in coal imports.*
McClelland, 1961.

enough to have slaves rear their children, caring for their every need. As you will see presently, this kind of treatment is likely to produce adults with a low need for achievement.

What about the behavior of individuals in everyday situations? A number of studies have shown that achievement motivation makes a difference in laboratory situations as well as in real life. Laboratory studies have shown that high need achievers will tend to prefer tasks in which there is a moderate amount of risk involved, as opposed to tasks that are too easy or too difficult. In one study college students played ring toss, in which they tried to toss a ring onto a peg from a distance of their own choosing. High need achievers took most of their shots from intermediate distances, in contrast with low need achievers, who used all available distances. The results are depicted in Figure 13.6. Apparently, neither a "sure thing" nor a "long shot" is satisfactory for a high need achiever, a moderate amount of risk being preferred (Atkinson & Litwin, 1960).

The need for achievement is also related to various measures of success

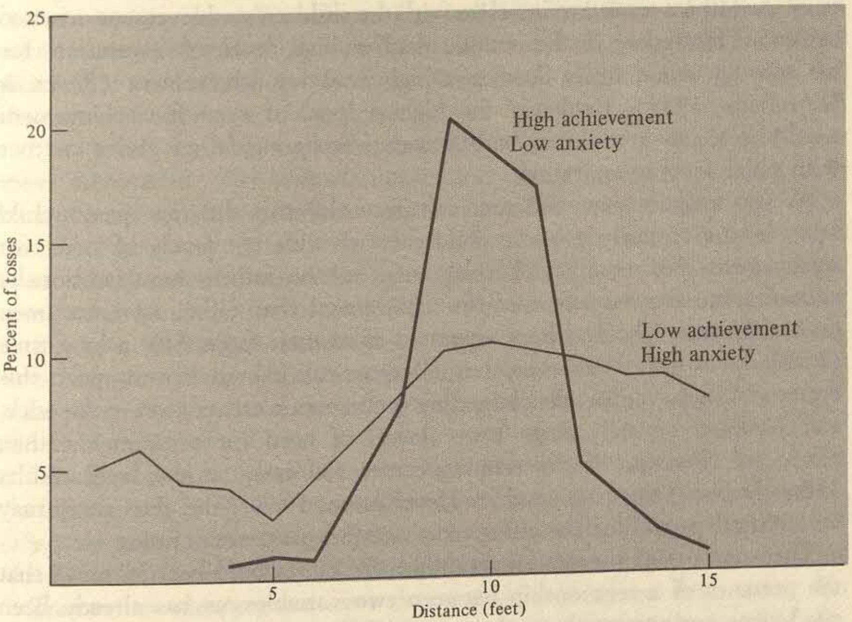


FIGURE 13.6

This figure demonstrates that individuals scoring high in need for achievement, when faced with a ring-toss problem, chose to throw from an intermediate distance. Individuals with a low need for achievement were more varied in their selection of distances. In this experiment the anxiety level of the subjects was also measured. The effect shown for high-need achievers was apparent only for those who were low in anxiety, and, similarly, the effect for low-need achievers was limited to those with high anxiety. Two other groups, one with low need for achievement and low anxiety, and the other with high need for achievement and high anxiety, were more varied in their selection of distances, like the low-need achievers shown in the graph.

Atkinson & Litwin, 1960.

in real life. There is a moderate relationship between the achievement motive and college grades, with high need achievers tending to have higher grades. Success in entrepreneurial activities is also related to the need for achievement, and some of McClelland's measures of achievement motivation are reasonably good predictors of success in business.

ORIGINS OF ACHIEVEMENT MOTIVATION

What are the antecedents of achievement motivation? McClelland assumes that the motive is learned on the basis of childhood experiences, and there is some support for this idea. In one study boys between 8 and 10 years of age were studied. The mothers of these boys filled out a questionnaire asking for information about the ages at which they expected the boys to do various things independently, such as make their own friends, master various skills, and take care of themselves. The results indicated that boys with a high need for achievement had more demands placed on them at an earlier age than the low need achievers (Winterbottom, 1958).

Other studies have shown that children with dominant and authoritarian fathers seem to have a low level of achievement motivation, probably because the fathers tended to interfere with the children's achievement-oriented behavior. However, if the mother had a high level of aspiration for her son, he would likely develop a high need for achievement (Rosen & D'Andrade, 1959). Evidently the highest level of need for achievement would be found in children with a warm, accepting father and a mother with a high level of aspiration.

As you might expect, different cultures exhibiting different parent-child relationships typically produce children with different levels of need for achievement. For example, Turkish men, whose fathers are traditionally authoritarian, showed less need for achievement than either American men or Turkish men who had been separated from their fathers for a long time (Bradburn, 1963). However, not all cross-cultural studies support this notion. In Japan independence training occurs much earlier than in America, and Japanese typically show lower levels of need for achievement than Americans. Perhaps, if the training comes too early, a low level results (Hayashi and Yamaushi, cited by Heckhausen, 1968), and thus there may be a critical period for the effectiveness of independence training.

There are other interpretations, however. You should bear in mind that the presence of a relationship between two variables, as has already been cited, does not necessarily imply causation. It is logically just as sensible to suggest that the parents of children exhibiting independence at an early age react differently to their children than parents of less independent children. Although experimental studies are not likely to be made, and the question of causation of achievement motivation must be solved at best indirectly, you should be aware of the alternate interpretation (see p. 504). American psychologists are wont to assume that somehow parents are responsible for the way their children grow up, particularly when it comes to personality patterns. However, as you will see in Chapter 16, there are other ways to look at the matter; i.e., children with particular characteristics may cause their parents to respond to them in a particular way.

Increasing the Need for Achievement

Over the years a great deal of information about the origins of achievement motivation and its effects on behavior has been gleaned. The question remains, however; is it fixed, once it is established through whatever learning processes are responsible for it, or is it something that can be changed by some training procedure? Suppose that it could be changed. What would be the effects of, say, an elevated need for achievement on the behavior of an adult?

McClelland (McClelland and Winter, 1969) has attempted to modify the need for achievement in adults and has also assessed the effect of whatever changes took place on the behavior of his subjects. His project has been somewhat controversial because it involved going into a community in a foreign country, where the need for achievement is characteristically low and attempting to teach a selected few individuals to have a higher level of achievement motivation. Manipulating one's cultural proclivities has in the past led to publicity about the "ugly American," which partly accounts for the controversial nature of this project.

First of all, by means of what rationale might one try to alter achievement motivation? McClelland's notion was that this motive actually consists of a set of associative networks in the individual, networks that influence both one's way of thinking about things and his emotions in response to certain situations. In practical situations the need for achievement will be manifested in one's way of thinking and feeling about goals and how to meet them, and about standards of performance. Certain considerations, namely production and efficiency, are more likely to bear on one's thinking than other matters, such as one's friends and family and what they might think.

Would it not be possible to convince people to begin to think in the "achieving way?" Would not such people, once they learn to think "properly," be more successful at business activities? McClelland investigated these possibilities in a study in several towns in India.

Trainees in the program were first trained how to get high scores for need achievement on the TAT. That is, they were taught the essential elements of need for achievement: personal responsibility and the setting of realistic standards and goals, etc. Then the trainees were encouraged to apply this kind of thinking to themselves through discussions in small groups and with counselors. They were also taught how to go about finding ways to start a new business.

Whether or not achievement motivation was actually changed, these trainees, 47 in number, were able through their resulting business activities to create 135 new jobs and raise a considerable amount of capital. They were also rather pleased with the ideas behind the training because they arranged to continue their association with each other even after the

initial training was finished. Thus training in achievement has been shown to have some impact on people's behavior, whether or not internal motivational processes are changed. Long-range implications of this kind of program have yet to be determined, however.

In order that the results not be interpreted as simply artifactual, a control group was used, the members of which received no training. There was no increase in productivity in this group.

On the other hand, even the successful trainees showed a reduction in need achievement scores over a three-year follow-up period. What this means is anybody's guess.

FEAR OF FAILURE

A motive that is closely tied in with achievement motivation and, indeed, often interferes with its expression is the fear of failure. Thus some individuals do not try very hard, not because they do not wish to succeed, but because they are afraid that they might fail in trying. The fear of failure can be measured with TAT stories scored for the presence of failure imagery or stories in which a hostile environment interferes with success. There is also a Text Anxiety Questionnaire, devised by Mandler and Sarason (1952), which has been used.

The fear of failure is important in determining whether or not the need for achievement will affect a person's behavior. Thus the level of difficulty of a task that a person will voluntarily choose depends on both achievement and failure motivation. Subjects with a high fear of failure prefer tasks that are either very easy or very difficult, while those with a high need for achievement and a low fear of failure will prefer intermediate tasks, as the research described previously indicates (Heckhausen, 1968).

The interaction of achievement and failure motivation is seen in a study of sixth-grade students by Atkinson (1964). He found that students with a high need for achievement and a low fear of failure performed better in classes containing other students similar to themselves in academic ability. On the other hand, students with a low need for achievement and a high fear of failure did not do well in such classes. They preferred a more heterogeneous class. Apparently, students in the first category were stimulated by their achievement motivation to perform well when they saw that the situation was competitive and that their standing would be based on how well they could do in relation to their peers. Students in the second category, however, were more likely to become anxious in the competitive situation, which, in turn, caused them to perform more poorly.

Just as cultures differ in terms of the need for achievement, there are also differences in expression of the fear of failure. In one study German and American subjects were compared. By using stories from a test like the TAT, it was shown that the Germans were more likely to express their fear of failure directly, while American subjects were more likely to give stories in which the failures were blamed on a hostile environment. It was thought

that this difference related to cultural differences in the handling of failure experiences by young children (Heckhausen, 1968).

Affiliation

Hermits are the exception, rather than the rule. That is, most people prefer to be with other people than to be alone, at least most of the time. While the affiliative tendency is quite selective at times, i.e. not just anyone will do as a partner for affiliation, it is nonetheless quite powerful, and understanding the basis for it will take us a good way in the direction of understanding social behavior.

BASES FOR AFFILIATION

Child-rearing Practices. The affiliative tendency, like most psychological phenomena, is complexly based. On the one hand, it is quite clear that it is biologically necessary for the young of many species, including humans, to be fed and cared for by their parents or other adults. They would not survive without this care. You have also seen evidence that attachment behavior upon which this care ultimately depends, is biologically quite potent, and that, even in the human being, early social responses such as smiling may be based on innate dispositions.

On the other hand, it is also quite clear that with the human species patterns of child rearing differ considerably from culture to culture and even within cultures, and these differences play an important role in conditioning one's later response to other people. For example, even within families in our own culture there seem to be systematic differences in the strength of the affiliative tendency related to birth order. According to Schachter (1959) the strongest affiliation tendency is seen in first-borns, with decreasing tendencies for second-, third-, and fourth-born children. The reason probably lies in the decreased likelihood that later-born children will receive the doting attention, comfort, and consolation when injured, etc., that the first-born receives. Such parental behavior would quite likely lead through generalization to increased positive responses toward other people.

Fear and Anxiety. Affiliation with others has been shown to depend on whether one is afraid or anxious. Fear, you will recall, is the response to an *actual* threat, while anxiety is related to the *expectation* of punishment or other nonpresent unpleasant consequences. It is clear from the above discussion that fear should lead one to affiliate with other people on the basis of generalization of responses learned in childhood. This was demonstrated by Schachter (1959). Subjects who had signed up for an experiment were individually shown an impressive array of electronic equipment and were told that they would be shocked. One group (high fear) was told that the shocks would hurt, but ". . . they will do no permanent damage." For the other group (low fear) ths shock threat was minimized and described as at most a tickle. They were told that the equipment had to be set up, which would take about 10 minutes, and that the experiment was delayed slightly, and they were asked whether they wanted to wait alone or with some other

people. The more afraid the subjects were, the more they chose to wait with others, supporting the idea that fear tends to elicit the affiliative tendency.

Anxiety, on the other hand, seems to have the opposite effect. Sarnoff and Zimbardo (1961) showed this in an experiment similar to Schachter's. In one part of their study they manipulated fear in much the same way that Schachter did by telling their subjects that they were going to be shocked—they obtained similar results. In the other part, they manipulated anxiety. They made subjects anxious by telling them that they would have to suck on a baby bottle. The low anxious group were told that they had to blow whistles and balloons and smoke toy pipes. When asked whether they wished to wait alone or with others, the subjects in the high anxious condition chose to wait alone more often than the low anxious subjects. The results are shown in Figure 13.7.

Why should fear and anxiety work differently in this situation? Perhaps the reason lies in the fact that, in anxiety, there is the threat of implicit or

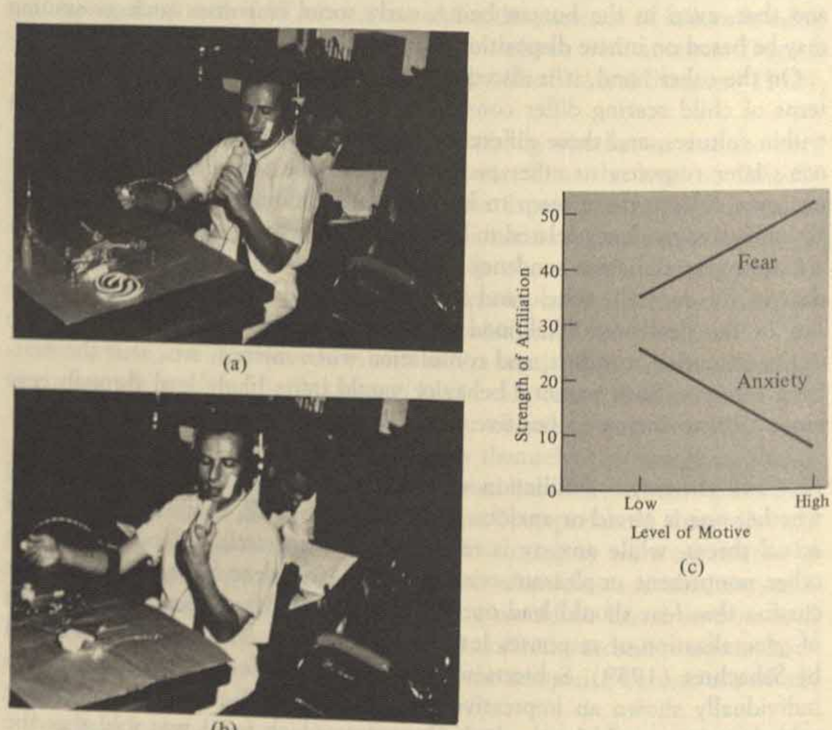


FIGURE 13.7 *Sarnoff & Zimbardo's experiment on the effects of fear and anxiety on strength of the affiliative tendency. (a) A subject is about to suck on a baby bottle, a condition designed to induce anxiety; (b) he is about to blow on a whistle, an action that should not produce much anxiety. The results are shown in (c). Note that affiliation increased with fear but decreased with anxiety. Sarnoff & Zimbardo, 1961.*

explicit censure from another person or perhaps the other person would be a source of embarrassment. It would certainly be the case in the Sarnoff and Zimbardo study, where the unpleasant consequences are most likely to be ridicule. It remains to be seen whether other forms of anxiety will also lead to that result.

Social Comparisons. Another basis for the tendency to affiliate lies in what Leon Festinger (1954) has called *social comparison.* The idea is that our evaluation of our behavior is based upon norms derived from interaction with other people. Interaction is perhaps also necessary for interpretation of certain inner feelings as well. You will see in the next chapter that interpretation of emotional feelings may depend on information from other people. In the present context affiliation may make it possible for one to compare his feelings with those reported by other people. "Am I overreacting to all that electronic equipment?" "Is the shock really going to hurt that much?" "Am I really being too blasé about the whole thing?"

In the real world, it is well known that a crisis can tend to cause people who would otherwise go their own ways to bond together to meet the demands imposed. Floods, tornadoes, and other natural disasters have frequently led to increased affiiliation. The bombing of Britain during World War II served to solidify the affiliative relationships among the victims.

INDIVIDUAL DIFFERENCES

Like achievement motivation, the need to affiliate differs from person to person. Studies have shown that people who score high on achievement motivation also report that they use the telephone more (at least for local calls), visit out-of-town relatives more, and write more letters than low scorers (Lansing & Heyns, 1959).

The need for affiliation also interacts with other motives, particularly the need for power and for achievement. In the latter case, McClelland (1961) has suggested that it is often hard for a businessman to be successful if he has at the same time a high need for achievement and a high need for affiliation. In many cases behavior toward one's associates, which is in the service of achievement motivation (encouraging efficiency, productivity, etc.), runs counter to one's need for affiliation, according to which friendship would be considered more important than productivity. McClelland notes that Mexican businessmen are more affiliative than Americans and tend to be less successful; the exceptions, however, with high need for achievement and low need for affiliation, are quite successful.

Power and Dominance

One of the basic needs that Murray postulated was the need for dominance, which included being a leader, being able to persuade and have an influence over others, and in general to have rather direct control over other persons. In current language this description amounts to power, and many psychologists now use that term rather than dominance.

Physical Space and Interpersonal Behavior

Space is a very pervasive concept. Architecturally, it is room in which activities can be performed. Esthetically, it is what gives us a sense of freedom or confinement, or pathways for movement or obstacles blocking our paths. In a personal sense it is what maintains our separateness as individuals. Although two people may have a "meeting of the minds" or may touch each other, they are ultimately separate because of the spatial boundaries of their bodies.

Psychological space does not stop with the body, however. For most people, as well as most reasonably high-level animals, there is an area surrounding the body which might be termed one's "personal space." Violation of this space by other organisms may lead either to attack or to retreat. There is evidence that members of different cultures have different conceptions of what is one's proper personal space. A comfortable interpersonal distance may be somewhat greater in the case of, say, Englishmen than in the case of Arabs. Edward T. Hall has written a very readable book entitled The Hidden Dimension *(1966), in which he outlines many of the ways in which space is important psychologically.*

What does space have to do with social motivation? Actually, it is probably quite important for understanding both affiliation and aggression. However, interest in the psychological aspects of space has just begun to bud, and as yet we cannot point precisely to the ways that physical distance between persons affects their interaction. On the other hand, a start in this direction has been made.

In an ongoing research project at Georgia State University, James Dabbs and his colleagues have begun some very basic studies into how people use interpersonal space and how variations in interpersonal distance affect their behavior.

Consider, for instance, the problem of crowding, which is basically a forced reduction in the freedom to establish a comfortable interpersonal distance. What kinds of reactions occur, and does it make any difference who is crowding whom? In one study (Dabbs, 1972) 321 pedestrians on a busy sidewalk in Atlanta, Georgia, were observed when they were purposefully crowded by a male or a female experimenter. The "crowdees" were more likely to move away when the crowder was male, particularly at bus stops. Female "crowdees" were more likely to move away than males. Without attempting to explain why females move away more than males, Dabbs suggests that the main difference between a stop light and a bus stop is in the likelihood that a social interaction might occur. None would be anticipated at a stop light, but a long wait for a bus might prove awkward if no

social interaction were desired. Since interaction with a strange male would presumably be less desirable than interaction with a strange female, more movement occurred under the former condition.

It has also been noted that animals tend to gravitate toward large objects in their immediate environments. Monkeys, for instance, tend to gather around objects. It was noted incidentally that some people, in walking down hallways, tended to keep to one side, near the wall, rather than walk down the middle. In one sidewalk study "gravitators" and "nongravitators" were identified and interviewed. The experimenter noted how close he could get before the subject moved away, and how long the subject would talk to him. Subjects who kept close to the walls of the building were slightly more prone to leave the interview earlier (and slightly more likely to move away from the approaching experimenter sooner). It was suggested that the gravitators tended to withdraw from social contact more than the nongravitators. Why this should be the case remains to be seen, and perhaps future research will explicate the attraction that large structures have for some individuals and how this attraction relates to other people.

In another study subjects (college students and prisoners) approached one another either in the center of a room or in one corner, and stood at a distance that they considered to be comfortable for conversation. Both groups of subjects chose a greater distance when in the corner than when in the center of the room. Furthermore, the prisoners preferred a greater distance than the students. Perhaps, it was argued, the type of companion the prisoner is likely to have while in prison would serve to increase the comfortable interpersonal distance. Also, the prisoners would not permit another person to move as close to them as they themselves would move to another person. This distinction between approaching and being approached may also be related to the realities of prison existence. This difference was not found for college students.

The authors suggest that perhaps being "in a corner" may "arouse formidable and primitive feelings" related to fear, and note the significance of "having one's back to the wall" in several different contexts (Dabbs, Fuller, & Carr, 1973).

Obviously, this research at its present state of development leads to practically no firm conclusions. It is instructive, however, because of the relatively simple methods used to investigate the problem. Furthermore, it is more or less characteristic of studies exploring the role that space plays in human behavior, and we may expect eventually to learn more from this kind of study.

The importance of power needs is suggested in the writings of the philosopher Nietzsche, and more recently in the work of the psychoanalyst Alfred Adler. Adler thought that people naturally develop basic feelings of inferiority during childhood and then spend the rest of their lives trying to

compensate for these feelings by striving to gain power. Frustration of one's strivings for power leads to anxiety and the "inferiority complex" (Adler's term).

More recently, psychologists have given some consideration to the need for power, although there is not nearly so much research on this need as there is on the needs for achievement and affiliation. McClelland (1961), whose main interest was in achievement motivation, nevertheless considered that the power need was an important determiner of the shape of a society. By analyzing the fantasy contained in children's readers for stories in which power was a major aspect, he determined that nations whose people had a high need for power were more likely to have a dictatorship form of government, unless there were also expressed a high need for affiliation. The United States, for example, exhibits both a high need for power and a high need for affiliation, and McClelland suggests that the affiliative needs prevent our walking roughshod over other people in the service of power.

According to McClelland individuals differing in the need for power seek different occupations. Executives high in power needs, for instance, are more likely to be in private than in public employ, since they are less subject to arbitrary control from above. Harvard students with high power needs were also different from those with low power needs. Using a measure of the need derived from TAT stories, Winter (1968) found the "high power" students were more likely to have motorcycles, private bars, cars, television sets, and wine glasses than "low power" students with an equivalent amount of money. Other non-Harvard, middle-class males were found to drink more and drive faster, were more likely to watch television shows such as "Mission Impossible," and to read *Playboy* magazine. It was suggested that the basic strivings involved were for social power obtained directly through the prestige of having possessions or vicariously through television, sex, and drinking. It is interesting that these findings did not hold for a group of working class males. Perhaps the power need as it has has been studied, i.e., as it is expressed in fantasy, is a middle- and upper-class phenomenon. There are other indications (see Chapter 18) that many of the psychological constructs which have been developed are class-dependent, and, in particular, do not apply very well to lower class, poor people.

Dominance is by no means a uniquely human characteristic. It is a phenomenon that can be observed in many different animal societies as well. Chickens, for instance, when placed together in a pen, will establish a "peck order," whereby the "top chicken" can peck all the others, the next one down can peck all but the top chicken, etc. This order is established by fighting and other aggressive displays, and, once it is established, seems to serve the function of reducing overt fighting. Primate societies also exhibit dominance hierarchies, whereby one animal, usually a male, dominates the rest. He gets the choicest food, his choice of females, and the best place to sleep. He decides when to move from one location to the next, where to spend the night, and where to eat. In turn he assumes responsibility for

leading the group in fights with other groups. Whether the dominant animal protects his position because of a "need for dominance," of course, remains to be seen.

Summary

Social motives affect the behavior of humans and other animals in relation to other members of the species. Some social motives are biologically based (e.g., sex, maternal motivation, aggression), although learning plays an important role. Others seem to be almost exclusively learned (achievement, fear of failure, affiliation, power and dominance). Social motives may be understood as psychometric traits on which individuals differ, as an organized hierarchy of factors that serve to provide a focus for a person's behavior, or simply as a set of learned responses to social situations.

Sexual and maternal behavior are partly under control of neural and endocrine factors, and partly determined by learning. Learning plays a much greater role in higher animals, such as primates, than in lower ones. The sex hormones testosterone (male) and estrogen and progesterone (female), as well as prolactin, which controls brooding and feeding, exert their influence on behavior through their effect on centers in the hypothalamus. Social deprivation has a deleterious effect on maternal behavior in monkeys, and presumably in other primates. The young of some species become attached to their mothers through imprinting. In other cases the warmth and contact comfort provided by the mother is important.

The origin of aggression is a controversial issue. On the one hand, there is biological evidence that aggression is an innate predisposition in some species, including humans. It is especially prevalent in males, a fact that is related to the presence of the hormone testosterone. On the other hand, the existence of biologically determined "flight" reactions and nonaggressive human societies suggests that aggressiveness is a product of acculturation, i.e., is learned. There is evidence that experiencing aggression, such as often occurs while watching television, is itself an instigator of aggressive behavior. Imitation is partly responsible for this effect, but other processes may also be involved.

Social motives are assessed by an analysis of individuals' fantasy productions, as in the Thematic Apperception Test, or by paper and pencil tests such as the Edwards Personal Preference Schedule and the Adjective Check List. Different measures of the same motive may not always relate to each other very well, indicating that the different tests test different things.

Learned motives that have been studied recently include achivement, fear of failure, affiliation, and power and dominance. Achievement motivation seems to be a product of particular forms of socialization involving relatively early independence training, as well as a strong interest on the part of the mother in achievement. High need achievers tend to produce sons

with low need for achievement. High need achievers tend to be more successful in entrepreneurial activities, make higher grades in college, and prefer tasks in which there is a moderate risk of failure. Fear of failure often conflicts with need for achievement, and, when it is activated, may actually hamper performance.

The need for affiliation arises as a response to fear, probably on the basis of generalization from early experience with maternal protectiveness. Anxiety, or the fear of behaving inappropriately, on the other hand, tends to reduce affiliation. Affiliation is also thought to be related to a need for social comparison, i.e., to compare one's feelings, behavior, etc., with that of others. Affiliative needs often interfere with achievement, since maintaining friendships and striving for efficiency and productivity are often incompatible.

Power and dominance needs are satisfied by having control over other people. In combination with low needs for affiliation they may lead to dictatorships. Power needs may be expressed via possessions that carry social prestige, or vicariously, through drama and literature. Dominance is seen in many different animal societies, and the establishment of a dominance hierarchy seems to inhibit fighting that might otherwise lead to destruction.

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Emotion

14

Of all the phenomena with which psychology deals, the emotions probably command the largest measure of our attention, yet are among the least well understood. These major components of the psychological life of human beings have always aroused controversy. They have, from time to time, been contrasted with "rational" processes as though the operation of the one were harmful and the other good. Thus some writers point out that emotions so promote disorganization—by interfering with such cognitive processes as perceiving and thinking—that one is less well able to respond to the "real world." Plato, the Greek philosopher, argued that one of man's main problems is to control "the beast within," which serves mainly to hinder rational thought.

Now the emotions receive a better "press," at least in some quarters. Leeper (1948), for instance, a psychologist, has argued that the emotions are processes that serve to *organize* rather than disorganize behavior, and several other psychologists have argued that the emotions are the basic stuff out of which all motivation arises.

The terms "emotional health" and "emotional disorder" imply that emotions are somehow involved quite intimately in problems of mental health, and it is not uncommon to hear it said that most of man's problems are emotional problems. Even in the field of medicine one encounters the idea that some physical illnesses (psychosomatic illnesses) are actually emotional in their origin. And it can be argued that understanding emotional processes is quite basic to understanding almost all aspects of psychological functioning, and many aspects of physiological functioning as well.

In the first section of this chapter you will encounter some of the ways the term "emotion" is used by psychologists. That is, the meaning of the construct will be discussed. Next, emotion will be discussed from the point of view of its physiological, motivational, cognitive, and behavioral aspects. Finally, you will see how the operation of emotional processes changes with development, particularly the way the different emotions come to be ex-

pressed, and the way in which one's responsiveness to the emotional state of another person develops with age.

The Concept of Emotion

The concept of emotion refers to several different types of phenomena. The term may be applied to a set of feelings or to a particular pattern of behavior labeled "emotional." It also is closely tied in with motivation and may refer to particular physiological states.

Feelings

You are probably most familiar with emotions as a particular set of *feelings.* You may, for instance, feel angry because your professor asked you some questions on the examination that you did not think were going to be on it, or you may feel a sense of satisfaction or contentment after making an A in a difficult course. Joel Davitz (1969) set about asking a large number of people about their emotions in an attempt to develop an understanding of the words used to describe particular emotions; he very quickly came to the conclusion that, for most people, the term applies to particular feelings (see Table 14.1).

Behavioristically oriented psychologists tend to prefer *not* to discuss emotions as feelings, since feelings are subjective. As such, they are hard to study in any way that is open and public, and that is likely to produce consistent data. People's feelings are thought to vary so much that some psychologists can only foresee discouragement in attempts to organize them. However, as you will see later, there is much recent work aimed at presenting an organized picture of emotional feeling states, and the results are encouraging.

Responses

One may also think of emotion as a particular kind of *response.* The term *response* not only means an overt piece of behavior but may also refer to an

TABLE 14.1 *Davitz's Dimensions of Emotions and the General Features of Behavior and Experience, Both Positive and Negative, Related to Each*

	Features		
Dimension	*Positive*	*Negative Type 1*	*Negative Type 2*
Activation	*Activation*	*Hypoactivation*	*Hyperactivation*
Relatedness	*Moving toward*	*Moving away*	*Moving against*
Hedonic tone	*Comfort*	*Discomfort*	*Tension*
Competence	*Enhancement*	*Incompetence: Dissatisfaction*	*Inadequacy*

Source: Davitz, 1969, p. 143.

internal process that occurs as a result of particular environmental conditions. In other words, emotion is a construct, or intervening variable, like other psychological terms you have encountered. It cannot be observed directly but must be inferred from overt behavior.

Several investigators have discussed emotion as a response to one's perception and judgment of a particular stimulus situation. When a situation is evaluated from the point of view of its personal significance, the outcome of this evaluation may be positive or negative. That is, if a situation is appraised as potentially threatening, then a negative emotion such as fear will be the response. If it is appraised as potentially rewarding or pleasurable, then a positive emotion will result.

Other investigators see emotion as a response to certain physiological events that occur during arousal (Chapter 12). One of the earliest of these ideas was put forth by William James, who suggested that a particular emotion was a response to (i.e., one's perception of) the bodily changes such as increased heart rate, "butterflies" in the stomach, etc., that occur in emotion-provoking situations.

These ideas will be developed more fully later when we consider some of the cognitive and physiological causes and effects of emotion. The main point for now is that you understand that emotion is sometimes viewed as an internal response to external or internal stimuli of personal significance.

Motivation

Emotion may also be viewed as simply one aspect of motivation. In this sense emotions are just especially strong motives. As such, they would presumably induce the animal to do something, i.e., to behave, so as to eliminate the motive. The work of Neal Miller discussed in Chapter 12, in which it was shown that rats would learn a new response in order to remove themselves from an environment in which they had previously been shocked, is quite in keeping with this point of view. The anxiety that presumably motivated the rats to learn the new habit was viewed both as an emotion and as a motive.

This view of emotion is the one that is favored by most behavioristically oriented psychologists because it makes it easy to bypass the question of feelings, and also puts emotion into a more general framework, that of motivation. One of the consequences of this notion is that when an emotion persists, it implies that the animal has somehow not been able to cope with the environment. Another consequence is that it becomes difficult to deal conceptually with positive emotions. In fact, the vast majority of the work done within this framework has been with the negative emotions of fear, anxiety, and hostility.

There is another way to look at emotion as motivation, however. Sylvan Tomkins (1970) has suggested that most of what we would ordinarily consider as primary motivation (e.g., as in Chapter 12) is actually "primary emotion is conceived as the *perception* of certain physiological states. Emomotives, which can operate effectively only if they are energized by emotional excitement or arousal. The motives are important, in that they specify

biologically relevant goals. However, they are, Tomkins argues, ineffective unless amplified by emotional excitement. Tomkins uses sexual motivation as an example, pointing out that the motive is rather ineffective unless it is coupled with emotional excitement. In fact, emotional feelings of guilt, incompatible with the excitement, may make sexual satisfaction impossible, even though the motive is quite intact.

The relationships between emotion and motivation will be considered again later. For the moment the main thing to remember is that the concept of emotion is closely related to, and, in some investigators' minds, identical with, that of motivation.

Physiological States

The concept of emotion also implies certain physiological states, and some writers would prefer to identify emotion with those states. You have encountered much of the relevant anatomy and physiology already, either in Chapter 4 or in Chapter 12.

William James's theory of emotion has already been mentioned, in which emotion is conceived as the perception of certain physiological states. Emotion has also been identified in terms of activity in particular areas of the hypothalamus (Cannon, 1929) or other areas of the limbic system (Papez, 1937). Papez identified "Papez's circuit," which consists of several limbic structures (see Figure 4.13), activity in which was thought to be the basis for emotional feeling and expression.

Later research has elaborated on these basic ideas, and it has become quite clear that the physiological processes underlying emotion are quite complex indeed. Some of the more recent findings in this area will be discussed later.

How Many Emotions?

Thus far we have considered "emotion" as more or less a general phenomenon. While we have used the plural, i.e., "the emotions," the question of "how many" or "what" has not been dealt with.

Different writers talk about different numbers of emotions. The number depends partly upon the extent to which one's conception of the meaning of the term permits differentiation into components. For instance, if one identifies emotion with motivation, then the number is limited by the number of different motives one wishes to consider. If emotion is identified with particular physiological states, then the number depends upon how finely one can differentiate among the relevant patterns of physiological activity. If the concept is that of a set of feeling states, then a wide range of emotions may be discussed, since people are capable of many different feeling states.

Although there are no final answers to the question of how many emotions there are, it would seem useful to consider one or two different schemes, with the aim of giving you some idea as to how psychologists have approached the problem.

Davitz (1969), whose work has already been mentioned in this chapter, has suggested that emotions may be described in terms of four primary emo-

tional factors, or dimensions: *activation*, *relatedness*, *hedonic tone*, and *competence*. As shown in Table 14.1, each dimension may be expressed positively or negatively.

Other writers have assumed a more intuitive approach to the question. Izard, for instance (1971), taking into account the writings of many people about emotions, suggests a list of eight fundamental emotions:

interest-excitement

enjoyment-joy

surprise-startle

distress-anguish

disgust-contempt

anger-rage

shame-humiliation

fear-terror

His approach, which is one you will see more of later when we consider emotional communication, is that these fundamental emotions are communicated in a culturally universal way by particular facial expressions.

Other writers have provided different lists. Robert Plutchik (1970) conceives of the emotions as lying within a solid figure that depicts the relationships between the various states. The solid is shown in Figure 14.1. The primary emotions are distributed around the solid, with the vertical dimension indicating differences in intensity. Thus sadness, grief, and pensiveness represent the same basic emotion, with grief being the most intense. He also notes that the emotions may be described in different ways, depending upon whether one is talking about feelings, behavior, or the adaptive function that the emotion plays. The relationships between these types of description are shown in Table 14.2.

If this rather long introduction to the concept of emotion has left you with the idea that the subject matter is poorly integrated, and somewhat contradictory and confusing, then you have gotten the main point. Growing pains are common in any newly developing area, and emotion is just that, partly because it was not fashionable to discuss feeling states in American psychology for 50 or so years, and partly because recent methodological advances, particularly in physiological psychology, have provided a rather concrete base for considering emotional expression.

The Physiology of Emotion

Regardless of how emotion is conceived, it is clear that it is intimately tied in with physiological processes in the brain and in the rest of the body. Over the years there have been two main approaches to the question of how

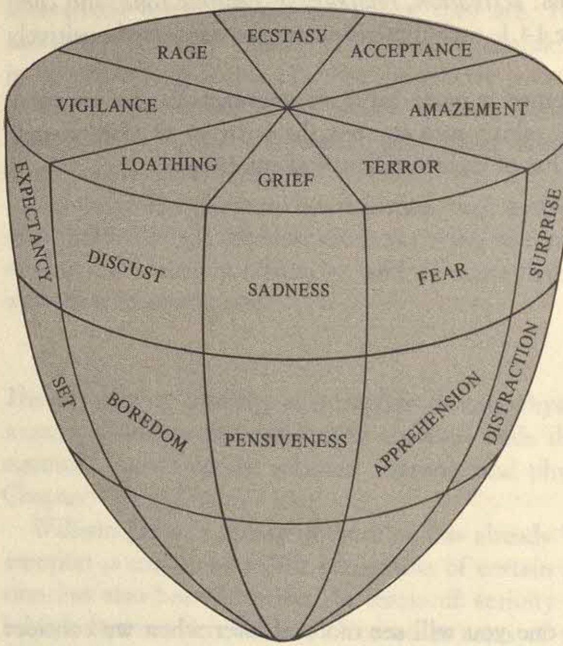

FIGURE 14.1 *Plutchik's Emotional Solid. It is to be interpreted more or less like this: The different slices, as of an orange, represent different "primary emotions." The different levels of each slice represent different intensities of each primary emotion. Terror, fear, and apprehension, for instance, represent the same primary emotion but differ in terms of the intensity of the experience.*
From Plutchik, 1970.

TABLE 14.2 *Emotional States (Figure 14.1) Described as Subjective Experiences, as Forms of Behavior, and in Terms of the Adaptive Functions Served by Each*

Subjective Experience	*Behaviors*	*Adaptive Function*
Fear, terror	*Withdrawing, escaping*	*Protection*
Anger, rage	*Attacking*	*Destruction*
Joy, ecstasy	*Mating, possessing*	*Reproduction*
Sadness, grief	*Losing contact*	*Deprivation*
Acceptance, greed	*Eating*	*Incorporation*
Disgust, loathing	*Vomiting, defecating*	*Rejection*
Expectancy, watchfulness	*Sensing*	*Exploration*
Surprise, astonishment	*Stopping*	*Orientation*

Source: From Plutchik, 1970, p. 11.

physiological states give rise to the emotions. William James (1890) suggested that emotional experience was the perception of bodily changes that occurred during an emotion-provoking situation. These changes included both internal, involuntary responses of the autonomic nervous system such as increased heart rate, trembling, diversion of the blood supply from the abdomen to the muscles and the resulting internal feelings, and increased epinephrine output; as well as changes in the voluntary, skeletal musculature such as facial expressions and postures. These responses combined in particular ways to result in particular emotional feelings. The essence of the notion is in the phrase "I am afraid because I am running," which seems to some investigators to be putting the cart before the horse. Intuitively, at least, one thinks of himself as running because he is afraid.

James's view was criticized by Cannon (1929). Cannon noted that people whose sympathetic nervous systems had been completely separated from the CNS (thereby presumably eliminating the feedback upon which James's theory relied) continued to experience emotions. He marshaled other evidence as well, including research findings which showed that cats whose cerebral cortex had been removed (thus eliminating their ability to perceive the bodily changes) would continue to show rage reactions in response to stimulation. These reactions could be elicited as long as the hypothalamus was intact; therefore, he considered that the integration of emotional expression depended upon activity in particular areas of the hypothalamus. Perception of the bodily changes, he argued, was of no importance.

Cannon's view of the importance of emotional "centers" has dominated the scene until recent times. However, in the last few years it has become clear that in keeping with James's view, perceptual processes are also important in understanding emotion. These developments will be discussed presently.

Centers for Emotion

Of major importance in understanding the physiology of emotion was the work of the neuroanatomist Papez (1937), who described the linkages between a number of structures in the forebrain that seemed to constitute a feedback system for the coordination of emotional expression. This system, known as *Papez's circuit,* includes the "limbic lobe" of the brain (so-named because it provides a border for the neocortical areas that are so prominent in higher animals), the hypothalamus, and certain other subcortical structures (refer to Figure 4.13, where the limbic system is described).

Since Papez's work there has been much research investigating the function of limbic system structures in emotion. For example, there is an area in the hypothalamus of the cat which, when stimulated electrically, will evoke an integrated defense reaction, including hissing, fluffing of the hair, and an escape posture. This area, in interaction with another area in the midbrain, seems to provide for integration of this type of emotional behavior (de Molina & Hunsperger, 1962).

Other studies have shown that stimulation of the amygdala, which is in front pole of the temporal lobe, can produce emotional reactions as well (see

Violent Behavior and Brain Function

In recent years there has been an increasing recognition of the problem of violence in civilized society. Violence in the streets, homes, and schools, police brutality, nationally condoned violence, televised violence, and violence on the highways have all received a great deal of publicity. Many explanations have been offered to account for violent behavior. Some focus on learning and imitation; others cite the effects of cultural and economic deprivation on social behavior; and still others point to hereditary causes of violent behavior.

Two investigators, Vernon Mark and Frank Ervin (1970), have suggested that at least some of the unprovoked assaults of one person against another may be caused by subtle forms of brain disease involving the limbic system. They describe two cases in which a relationship between activity in the amygdala, which is part of the limbic system in the temporal lobe, and violent behavior was suggested.

Thomas R. was an engineer who, a number of years previously, had suffered brain damage, due to shock. His behavior was quite violent at times; he would attack his wife and behave in a violent and dangerous manner when provoked while driving a car. It was found that electrical stimulation of certain parts of his amygdala through implanted electrodes would make him feel quite good for long periods of time, and during such periods he had no rage attacks. On the other hand, stimulation of another part of the amygdala would result in a rage reaction. When the part that elicited the rage reaction was damaged, his attacks of rage ceased and, at the time when the report was made, had not recurred for 4 years.

Another patient, Julia S., had suffered brain damage from encephalitis at age 2. Her behavior was at times quite violent, and on 12 different occasions she had seriously assaulted people for no apparent reason. One victim almost died from a stab wound in the heart. There was evidence of gross abnormality of brain functioning, and electrodes were placed in her amygdala. It was discovered that electrical stimulation in the amygdala would provoke a violent attack of rage. After both right and left amygdalae had been damaged, there was a sharp reduction in the incidence of rage attacks over the 2 years immediately preceding the writing of the report.

These findings do not mean that everyone who behaves violently has some form of brain disease, nor is it suggested that neurosurgery is the answer to all such problems. Indeed, follow-up studies of the engineer Thomas R. (Chrover, 1974) indicate that the aftermath of such operations may be personally disastrous. Damaging brain cells that do not grow back is always a serious matter, and the full extent of psychological consequences of a given operation is never fully known. However, this line of work points to the fact that any understanding of such behavior must take into account physiological as well as sociological, psychological, and economic factors.

p. 402). Human patients with epilepsy involving abnormal activity in this region of the brain may, when going into an epileptic seizure, experience a variety of vivid emotions. It has already been mentioned in Chapter 4 that violent activity may be prompted by abnormal stimulation of this area.

Another area that has been extensively explored is one known as the septum. This is one of the areas identified as a "pleasure center," in that rats and other animals will work very hard in order to receive electrical stimulation there (see Chapter 12).

The cerebral cortex is also involved in emotion. You have probably heard of the brain operation known as *prefrontal lobotomy*, which used to be performed to relieve patients of anxiety. The operation actually involves severing the neural connections between the prefrontal lobe of the cortex and the thalamus. The operation is usually effective in alleviating anxiety but, unfortunately, alleviates such things as the ability to plan ahead, and other positive emotions, as well. The fact is brought up here because it points to the idea mentioned earlier that an important aspect of emotion is the anticipation or expectation of certain events' happening. It is possible that the frontal lobe is closely involved with this feature of emotion.

Physiological Feedback and Emotion

Whenever the brain is active, something happens that sends additional information back into it, i.e., feedback occurs. When your arm moves, information about the change in position is fed back into the brain and provides a basis for coordinating subsequent movements. In the case of emotional expression there are several different types of feedback that occur. One category of feedback is *chemical*. When, for instance, the sympathetic nervous system is active, the adrenal medulla secretes epinephrine, which causes the heart to beat faster, the blood to divert from the gut to the muscles, the hairs on the back of the neck to raise, etc. These same responses also occur as a direct effect of sympathetic activity, but they are prolonged by the epinephrine that is secreted into the bloodstream. The responses, however, feed back into the nervous system and evoke feelings of agitation, arousal, uneasiness, etc. This is part of what William James was talking about when he formulated his theory of emotion. There are other chemical effects of activity in the various emotional centers mentioned previously, but we shall not discuss them here. Presumably they, too, have feedback effects on the nervous system.

Another kind of feedback comes from the skeletal muscles when they are postured in particular ways. Muscle tension produces a certain pattern of feedback, while relaxation produces another. The neurophysiologist Ernst Gellhorn (1968) has pointed to the fact that autonomic activity elicited from stimulation of the hypothalamus can be altered with drugs that affect the state of tension or relaxation of the skeletal muscles. He has suggested that relaxation may indeed alter emotional experience (there seems to be no question about the reverse effect, that a reduction in emotional activity promotes relaxation, but Gellhorn's position is that it works both ways). Of particular importance is proprioception coming from the region of the face,

which, as you know, is quite important in emotional expression. (See Figure 14.2.) An implication of this point of view is that a happy face can make you feel happy, and a sad face can make you feel sad. This is the remainder of what William James was talking about in his theory. Feedback from skeletal muscles and proprioception is an important aspect of his contribution which has been relatively ignored, relative, that is, to his ideas about feedback from the internal organs discussed above.

PHYSIOLOGICAL DIFFERENTIATION OF EMOTIONAL STATES

In view of the nuances of emotional experience and expression that are possible in human beings, one would expect that some patterns of physiological activity could be found which would provide the basis for these different emotions. However, such has not been the case. Although the brain stimulation work discussed previously indicates that, to some extent, different centers may be involved in grossly different emotions, measurements of physiological processes, e.g., sympathetic nervous system functions, have not turned up much in the way of different patterns related to the different emotions. The sympathetic nervous system and its chemical counterpart epinephrine seem to act in quite a diffuse way. Emotional arousal is a diffuse phenomenon, then, and the question remains as to how the different experiences of emotion are to be explained. Research discussed in the following sections seems to contribute possible answers.

INTERACTION BETWEEN PHYSIOLOGICAL AND COGNITIVE FACTORS

Two lines of research, one with humans and the other with animals has indicated that emotional differentiation may depend upon both physiological arousal and one's perception of his environment. You have already encountered one instance of this idea in the chapter on motivation, where the sexual behavior evoked by brain stimulation in a male monkey was shown to depend upon whether another male was present or not and the dominance relations between the two males.

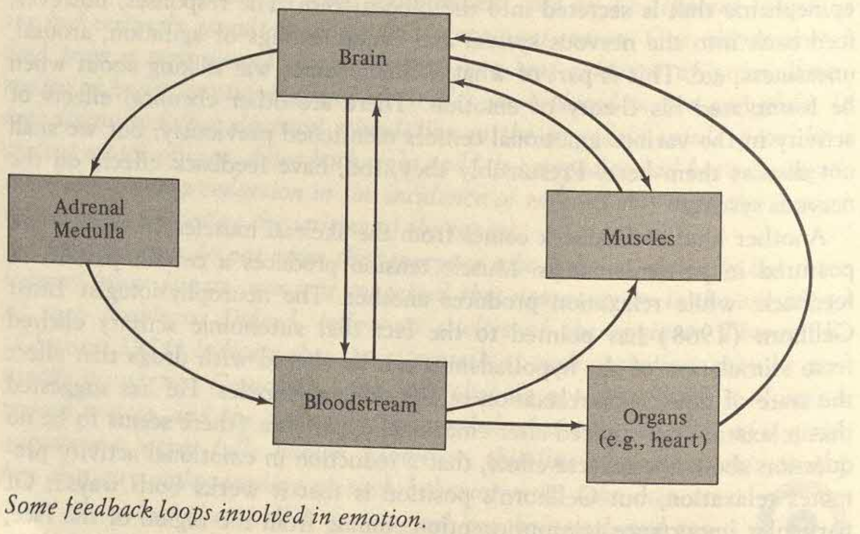

FIGURE 14.2 *Some feedback loops involved in emotion.*

Three Hungarian investigators, Kopa, Szabo, and Grastyàn (1962) made the following observations. (See Figure 14.3.) Cats were trained to jump onto a platform in order to avoid electric shock delivered to the floor of the apparatus. The warning signal was a tone, and the animals had 5 seconds to get onto the platform. Such a habit is quite easy to establish and is not in itself remarkable.

These animals, however, had electrodes implanted in their brains in an area between the thalamus and the midbrain. After the avoidance habit was well established, the investigators tried stimulating the brain through the electrodes and found that the reaction of the animals to the stimulation depended upon whether they were sitting on the platform (safe) or on the floor (in danger). Stimulation while on the platform produced a posture of contentment and relaxation:

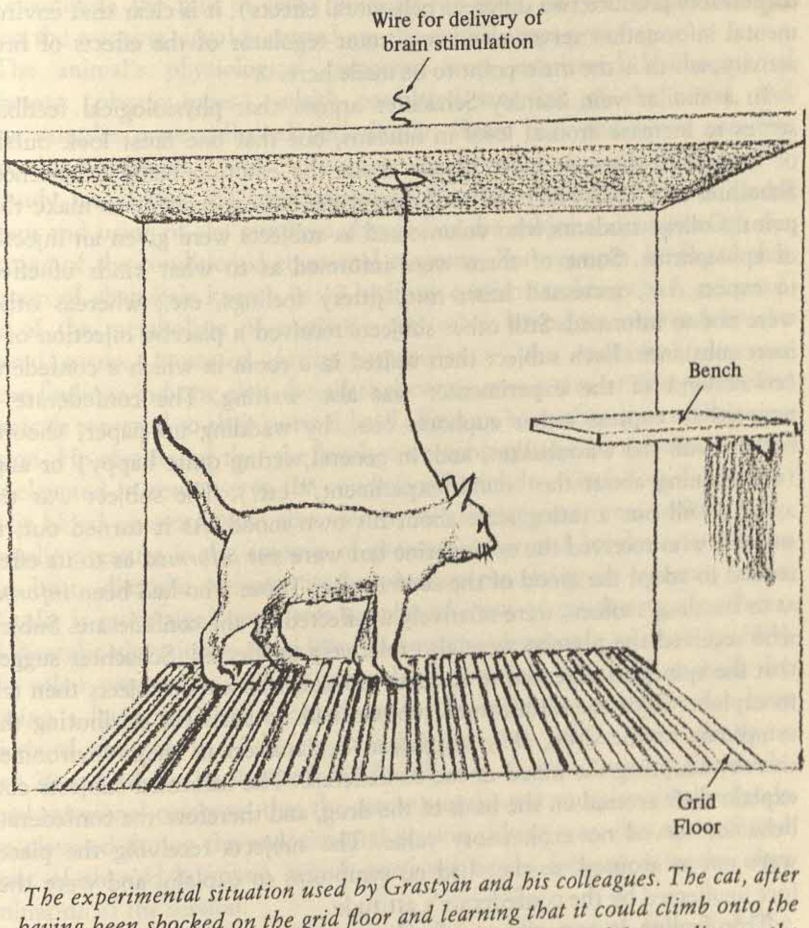

FIGURE 14.3

The experimental situation used by Grastyàn and his colleagues. The cat, after having been shocked on the grid floor and learning that it could climb onto the bench to escape, would, when stimulated in the thalamus while standing on the grid, climb onto the bench. If stimulated while on the bench, it would curl up and begin to purr.

From Kopa, Szabó, & Grastyàn, 1962.

> At the very beginning of stimulation the cat quietly looked around, bent its head progressively and eventually lay down in a posture characteristic of the sleeping cat. Sometimes even lid closure was observed. . . . At the termination of stimulation quick lifting of the head as well as anxious exploratory movements could be observed as a rebound effect (pp. 109–110).

Kopa et al. found that stimulation through the same electrodes while the animal was on the floor produced restlessness, agitation, and eventually jumping onto the platform. In other words, stimulation of the same site resulted in two different forms of emotional expression, depending upon whether the environment was perceived as safe or dangerous. Although it is hard to say whether only one area of the brain was stimulated by the electrodes or two or more different areas were stimulated (which would conceivably produce two different behavioral effects), it is clear that environmental information serves as an important regulator of the effects of brain activity, which is the main point to be made here.

In a similar vein Stanley Schachter argues that physiological feedback serves to increase arousal level in humans, but that one must look outside of himself to discover more details about the emotion being experienced. Schachter and J. E. Singer (1962) performed an experiment to make their point. College students who volunteered as subjects were given an injection of epinephrine. Some of them were informed as to what kinds of effects to expect, i.e., increased heart rate, jittery feelings, etc., whereas others were not so informed. Still other subjects received a placebo injection of an inert substance. Each subject then waited in a room in which a confederate (co-worker) of the experimenter was also waiting. The confederate attempted to express either euphoria (i.e., by wadding up paper, shooting baskets into the wastebasket, and, in general, acting quite happy) or anger (complaining about the "dumb experiment," etc.). The subject was then asked to fill out a rating scale about his own mood. As it turned out, the subjects who received the epinephrine but were *not informed* as to its effects tended to adopt the mood of the confederate. Those who had been *informed* as to the drug's effects were relatively unaffected by the confederate. Subjects who received the placebo were also relatively unaffected. Schachter suggests that the epinephrine served to increase arousal, which the subjects then tried to explain. Since the uninformed subjects had no basis for attributing their symptoms to the drug, they sought an explanation in their environment, thereby adopting the mood of the confederate. The informed subjects could explain their arousal on the basis of the drug, and therefore the confederate's behavior served no explanatory value. The subjects receiving the placebo were not as aroused, so they had no symptoms to explain, and were therefore unaffected by the confederate's attitude.

This finding is reminiscent of others we have described earlier, which lead to the general conclusion that whatever the role played by physiological states in emotion, that role must be modulated in an important way by environmental information, i.e., by the operation of cognitive processes.

Physiological Consequences of Emotion

Prolonged emotional states may have physiological consequences. The term *psychosomatics* is sometimes applied to this area of study, implying that the mind (psyche) affects the body (soma). Some of these effects in humans will be discussed in Chapter 17. A program of research with monkeys will be described here.

Some of the physiological effects of emotion have been demonstrated by Joseph Brady (1970), who used Rhesus monkeys as subjects. The basic experimental situation is that depicted in Figure 14.4. The monkey is strapped into the chair, and is trained to press a lever in order to receive food on an intermittent reinforcement schedule. The animal is then presented with an auditory warning stimulus, followed by electric shock, and a conditioned emotional response is established (see Chapter 12). The auditory signal presumably becomes a conditioned stimulus for anxiety because it is predictive of the shock to follow, and its effect on the animal can be assessed by examining the rate of lever pressing for food. As you learned earlier, when the warning signal is turned on, the animal stops pressing.

The animal's physiological responses were monitored by means of catheters (plastic tubes), which permitted sampling of the blood, and urine samples were collected periodically. Heart beat and blood pressure were also monitored.

Brady found that the concentrations of various chemicals in the bloodstream and urine of the monkeys changed as the subjects went through the learning of the conditioned emotional response. For example, he found that a group of chemicals known as 17-hydroxy corticosteroids, which are products of the metabolism of cortisone and other hormones secreted by the adrenal cortex, increased during acquisition of the emotional response. These findings indicate that the adrenal cortex was active at that time. The chemicals returned to their normal level about an hour after the conditioning session. He also found that the level of norephinephrine in the bloodstream was elevated in response to the conditioned stimulus. Both systolic and diastolic blood pressure were also seen to rise during emotional conditioning. (Systolic pressure is the amount of pressure generated by the force of the heart beat; diastolic pressure is the pressure remaining in between beats. Diastolic is more significant from a point of view of psychosomatic effects, and diastolic elevation is considered to be more dangerous to one's health.)

In other experiments Brady trained his monkeys to avoid a shock by pressing a lever, and then kept them in the avoidance situation for long periods of time, up to 72 hours, during which they had to press the lever every 20 seconds or be shocked. He found, just as in the case of the conditioned emotional response, that the corticosteroid and norephinephrine levels were elevated during the experimental session. There was also an increased output of thyroid hormone, which persisted for as long as 3 weeks after termination of the session.

An interesting phenomenon occurred during the period following the avoidance session. The amount of pepsinogen in the bloodstream rose sharply. Pepsinogen is a chemical that is a precursor of pepsin, one of the digestive enzymes which breaks down proteins. This finding is quite sig-

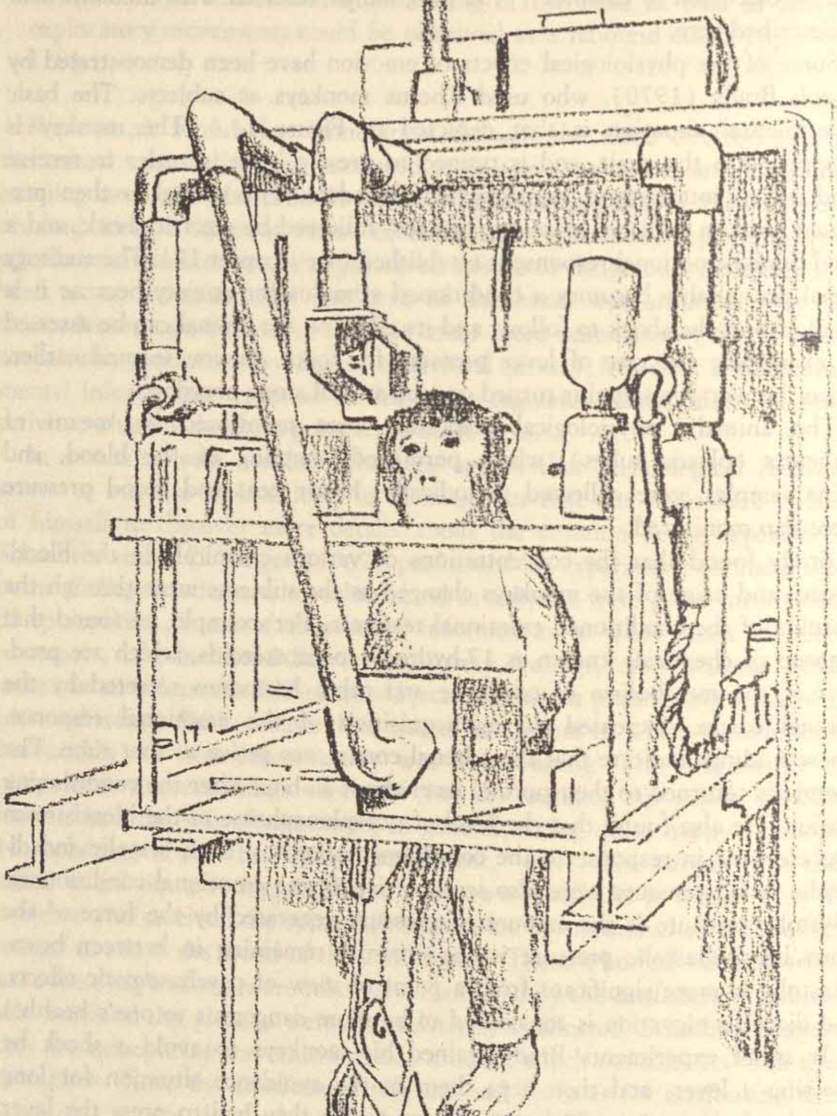

FIGURE 14.4 *Apparatus used by Brady (1970) in his experiments on physiological results of emotional experience. The monkey could be shocked in the chair and could also press a bar in order to avoid the shock. Water and food were available, and, because of the restraints, blood and urine samples could be obtained. From Brady, 1970.*

nificant because Brady found that some of his monkeys developed ulcers after having been through the prolonged avoidance conditioning situation. One of the immediate causes of ulcers is the digestion of the wall of the stomach or duodenum by this same enzyme, pepsin. In contrast, monkeys who were shocked equally as often, but who *could not avoid the shock,* did not develop ulcers.

All of the chemical and cardiac changes mentioned above are, when they occur in moderation, adaptive in that they mobilize the animal for dealing with the emotional situation. Cortisone is often secreted in response to stress and serves to reduce inflammation. Norepinephrine is a neural transmitter substance (see Chapter 4) that is involved in arousal of the central nervous system. Thyroid hormone increases the basal metabolic rate, again one of the responses mediating sustained arousal. The adaptive function of heart rate and blood pressure increases should be clear. However, when these effects persist over a long period of time, then they can produce damage to the body. Chronic stress, then, can result in hypertension (chronic high blood pressure), ulcers, inflammations of the skin, nervousness, and other unfortunate states.

Emotion and Motivation

Frustration

Whether or not it makes sense in the long run to regard emotions and motivation as being identical, it is quite clear that emotions may arise when motive satisfaction is blocked for some reason. The term that psychologists use to apply to the blocking of motive satisfaction is *frustration.* Frustration has played a major role in attempts to understand aggressive behavior, which is one form of emotional behavior. The frustration-aggression hypothesis, for instance, was advanced to account for aggressive behavior by Dollard, Doob, Miller, and Sears (1939), who argued that aggression in human beings did not occur spontaneously, but only as the result of motive frustration. Frustration due to the simultaneous operation of conflicting motives has been suggested as a major cause of personality disturbances, or emotional illnesses. Thus it is an important source of emotions.

Frustration may arise from several different causes, both internal and external. An external impediment may keep one from attaining a goal, for instance, when you are on your way to the beach for a weekend and the car breaks down. Frustration may also arise when one is prevented from attaining a goal because of some personal handicap, e.g., a person who wishes very much to become a doctor but cannot make the grades necessary to get into medical school. Emotions may arise in the face of such frustration, although the emotion is usually not long lasting, since something can usually be done about the situation. Cars eventually get fixed, and students learn to set their levels of aspiration more in accord with their abilities.

Conflict

Another kind of frustration, however, may be more difficult to handle, and its effects may be longer lasting and potentially more serious psychologically.

Conflict frustration arises when two or more conflicting motives occur at the same time in the same individual. Unless both motives can somehow be satisfied, there is always some frustration.

It is customary to label four kinds of conflict situations, based upon the nature of the motives that are in conflict. These situations are depicted in Figure 14.5. If both motives are positive, i.e., if one desires two different goals that cannot be attained simultaneously, then an *approach-approach* conflict is said to exist. For example, if there is a good television show that you want to watch, and also a good movie you would like to see, then approaching one of the goals would necessarily mean losing the other one, unless you have time to do both. This kind of conflict is not terribly difficult to resolve, since, once one of the goals is chosen, the other often appears less attractive than it did before. Agitation may occur at having to make the decision, but, unless it is very important to have made the *right* decision (e.g., if your date turns out to have preferred the other choice), emotional consequences are not serious.

If both goals are negative, then an *avoidance-avoidance conflict* is said to exist. Assuming that these were the only choices, would you rather go hungry or would you rather steal food, running the risk of being caught and put in jail? Is it better to study a dull subject and pass the course or fail and have to drop out of school? Some avoidance-avoidance conflicts can be resolved by avoiding both negative goals, or, in one terminology, "leaving the field." Other conflicts may not be so easy to resolve and can produce

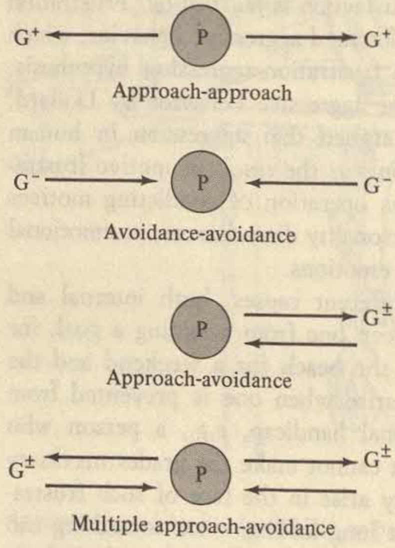

FIGURE 14.5 *Four types of conflict situation. The "P" represents the person; "G" represents a goal. The arrows indicate the direction of the behavior called for by a motive relative to that goal, and the + and − signs refer to the attractiveness or repulsiveness of the goal.*
From Lewin, 1935.

a good bit of hostility, feelings of alienation, and, in general, strong negative emotions.

Many goals are not univalent; i.e., they have both positive and negative aspects. A conflict involving such a goal is called an *approach-avoidance conflict,* and its resolution may be quite difficult since, in order to attain the positive features of the goal, it is necessary to endure its negative features. The movies and comic books are full of amusing accounts of such conflicts, such as the swimmer who sticks his toe into the water, feels that it is cold, and finally, after much vacillation, decides to jump in the water. Approach-avoidance conflicts occur quite often, however, and may be more problematical than simply deciding whether or not to jump in the water. Many motives may, when expressed, lead to punishment. Hostility is a good example. Aggression against another person is often punished, either by the law, by the person who is aggressed upon or, in the case of young children, by one's parents. Anticipation of this punishment may produce fear or anxiety, which can serve as a motive to inhibit expression of the hostile motive. Sex is another example, and some individuals may have difficulty expressing sexual motivation because of feelings of guilt or fear of punishment resulting from previous prohibitions.

Social motives such as achievement and fear of failure may come into conflict, as may dependency and autonomy needs; such conflicts may result in emotional difficulties, ambivalence toward life goals, and, in general, difficulty in adjusting to adult society.

A fourth kind of conflict is actually a complication of the approach-avoidance conflict. It is called the *multiple approach-avoidance conflict* because two or more goals exist, each of which has both positive and negative aspects. The goals are so juxtaposed that attainment of one of them not only forces one to endure its negative consequences, but also to move away from the positive consequences of some other goal. Another name for this kind of conflict is the "double bind."

Consider some of the implications of the free-wheeling life style that has recently been publicized. Adopting this way of living may be fun for a while, in that certain motives (e.g., sex and affiliation) may be satisfied, but lasting values (e.g., the creation of meaningful relationships based on other factors as well as sex) are often frustrated. To adopt the conventional morality, get married, and settle down may provide too many restrictions on one's freedom, although it may provide the basis for satisfying the need for more permanent relationships. Thus moving in either direction may have positive and negative consequences and, so to speak, "you can't win for losing."

When experienced at an early age, the double-bind situation has been thought by some investigators to lay the groundwork for the development of schizophrenic symptoms (Bateson, Jackson, Haley, and Weakland, 1956). As you will see later, emotional feelings may be communicated both verbally and nonverbally. When, for instance, a mother communicates one emotion, love, at the verbal level, but her gestures, postures, and facial expressions say that she would prefer to remain aloof, a sensitive child may respond to

both messages. The problem is that the two messages call for conflicting behavior, neither of which is unequivocally correct. It is suggested that under such circumstances, a child might think that adult communications do not make sense, any attempt to make sense out of them leads to the wrong consequences, and therefore why bother to communicate at all? Withdrawal from interpersonal relationships is one conceivable result. The main cause of withdrawal, according to this view, is the emotional consequence of the conflict.

The main emotional result of all conflicts involving avoidance is *anxiety*. Anxiety is a negative emotion related to fear. It often refers to the anticipation of punishment, although the experience may not be very specific with regard to the source of the punishment. Indeed, a person may experience anxiety without having any inkling of what it refers to. He simply feels jumpy, nervous, agitated, fearful, etc., without knowing why. Such "free-floating anxiety" will be discussed further in a later chapter when personality deviations are taken up, since it is quite often one of the accompaniments of a personality disturbance.

Positive Goal Attainment or Expectation

It seems intuitively clear that if the expectation of punishment and other negative consequences gives rise to negative emotions, then the expectation of positive goal attainment would lead to positive emotions. Imagine the anticipation of having a date with a new and exciting person, or of eating an excellent meal, or of making an A in a difficult course. The emotions involved are clearly positive, although the first example may also evoke some apprehension as well.

Unfortunately, psychologists have not spent the time analyzing the motivational causes of the positive emotions that they have spent on the negative ones. The recent humanistic movement seen in some areas of psychology is beginning to lay more stress on the positive emotions and their enhancement, but as yet there has been relatively little work of a systematic nature. Perhaps this state of affairs will change in the near future.

Cognitive Aspects of Emotion

You have already seen how cognitive and physiological factors may interact in emotional situations. The work of Schachter and Singer, in particular, is relevant here. Recall that the interpretation of one's physiologically aroused state was provided by one's perception of his environment. This work has had a major impact on our understanding of emotional states.

Another line of research within the cognitive tradition is that of Richard S. Lazarus (1968), who sees emotion as arising from a cognitive appraisal of a given situation. If the appraisal leads to the conclusion that a threat is involved, then a negative emotion will result. As a part of the emotional response, direct action may be taken against the threat or, as often happens, a reappraisal may occur, leading to the conclusion that the threat really is

not so bad after all. Such a "benign reappraisal" may lead to a positive emotion such as contentment, a feeling of security, or relief.

The original appraisal of a situation may itself be benign, in which case the negative emotion that resulted from threat appraisal does not come about. Quite often one's appraisal of a possibly threatening situation turns out benign because one has, in the past, learned adequate coping responses to remove the threat. For example, most adults do not experience much emotion when crossing the street, although that is a potentially dangerous situation. The emotion that may at one time have been experienced is no longer present because adaptive responses, such as looking both ways, have been well learned. Similarly, hot stoves rarely produce an emotional outburst in an adult, although most of us have been burned at least once at an early age. The potentially dangerous situation no longer produces emotion because a person has learned how to behave safely around a stove.

This "short circuiting" of the emotional aspect of the response as soon as adequate coping behaviors have been learned is seen in animals as well as in humans. It is often observed in training animals to make an avoidance. Although the subjects may appear emotional during the early stages of training, once the habit is well learned, the avoidance is usually accomplished without emotion.

Cognitive processes may also alter the emotional response resulting from stressful experiences. For example, investigators working in Lazarus's laboratory (Folkins, Lawson, Opton, & Lazarus, 1968) induced stress in subjects by having them view a film showing various accidents occurring in a woodshop. In one of them, a man is impaled in the chest by a piece of flying wood. As you would imagine, the film produced stress. However, the emotional response to the film, as measured by the conductance of the skin, was markedly reduced when the subjects were told beforehand what they would see and instructed to imagine the critical scene. Lazarus suggests that the reduction came about through anticipatory reappraisal of the personal significance of the accident for the viewer.

An emotional state may lead to cognitive activity, i.e., thinking about the situation. The thinking, or appraisal, does not necessarily have to be something one is aware of doing but may take place without awareness. Appraisal may be realistic, in the sense that it reflects accurately the realities of the situation, or it may be distorted. Both types are quite important.

Realistic Appraisal

Imagine yourself in this situation. You have just come to college from a successful high school career in which you earned, without even trying, a B+ average. Unfortunately, you were bright enough so that you did not have to learn to study efficiently. Now, having gotten through one semester of college work, you find that your average is barely a C. This kind of situation is not uncommon, and for various reasons it can be quite emotion-provoking. Anxiety, depression, guilt, and hostility may all be present to some extent. These emotions demand being dealt with, and at this point the distinction between realistic and distorted appraisal may be made.

Perhaps the best approach to such a problem would be to get information and to think: talk to one's professors to get their assessment of the situation, examine the course of events during the semester, come to some conclusion about what went wrong, and try to make realistic plans to improve the next semester. In other words, having appraised the personal significance of the situation and having recognized the resulting emotions, one can then make a realistic appraisal of the possibilities for the future.

This is perhaps the ideal outcome of an emotional situation, and, fortunately, is the one that occurs quite often. A 40-year-old man is told by his doctor that he has high blood pressure and that if he does not lose weight, stop smoking, and start exercising, he is likely to die at an early age. This is obviously an emotional situation, but the response of many people is to examine the alternatives realistically and take the doctor's advice.

Indirect cognitive effects of emotion may include *sensitization* to stimuli, or rather, to information, relevant to the causes of the emotion. The potential heart patient may be more likely to notice articles in the newspaper about heart disease; the frustrated student may be more likely to notice an announcement about a study habits clinic at the counseling center. You have already seen, in Chapter 5, that information can be processed at levels below that of awareness, and that one's emotions and motivations may affect this unconscious processing of information.

Cognitive Distortions

To continue with the example of the frustrated student, it is possible that the outcome of the emotional encounter with grades would not be so promising. Human beings have various processes at their disposal for distorting the cognitive aspects of the situation. One might, for example, rather than try to come up with an accurate assessment of the causes of the low grades, simply blame the professor, or the textbook, or say he was not interested in making good grades, anyway. He could use any of a large number of *defense mechanisms,* which serve the purpose of avoiding a confrontation with the realities of the situation.

Employing the mechanism of *denial*, the student might dismiss the importance of grades. He actually causes himself to feel that he does not care. Extreme denial, called *repression,* may prevent even the thought of caring from entering awareness. Denial and repression can be consequences of conflict situations as well. For instance, the conflict between sexual motivation and fear of punishment or guilt may result in denial of awareness of one's sexual feelings. The same reaction occurs often as a response to hostility, because hostility is often associated with retributive punishment and feelings of guilt.

Rationalization involves ascribing the failure to something other than the real cause, such as a poor textbook or a poor teacher.

Projection, another cognitive distortion, permits the student to attribute his failure to the hostility of the professor toward him. In other words, he *projects* his own hostility onto the professor.

Thus defense mechanisms may be seen as hindrances to adaptive behavior in emotional situations because they prevent or delay realistic appraisal. Why do they occur? Why does a person distort rather than appraise accurately? One reason seems to be that defense mechanisms *reduce anxiety*. Thoughts, particularly those relating to behaviors that one feels guilty about or that have been punished in the past, can produce anxiety, and the defense mechanisms may keep such thoughts from entering the level of awareness. Psychoanalytically oriented investigators and clinicians stress this aspect of the defense mechanisms.

Defense mechanisms may also *enhance self-esteem*, or at least prevent the deterioration that would occur from awareness of one's incapabilities. Recent writers, such as Abraham Maslow (1970), have pointed out that self-esteem is an important motive in human beings and is presumably strong enough to lead some individuals to distort their conception of reality in order to protect it.

To summarize briefly, an emotional situation may lead either to realistic appraisal (and, presumably, adaptive action in the future) or it may lead to distorted appraisals (and action that is not necessarily adaptive). Distortions seem to occur when anxiety or loss of self-esteem would result from a realistic appraisal.

Emotional Behavior

PREPARATION FOR FIGHT OR FLIGHT

Since many emotional situations are threatening, it would appear biologically adaptive that the behavioral reactions to an emotion would prepare one to do something about the threat—either fight it or flee from it. Some of these reactions are direct consequences of sympathetic arousal, and have already been discussed. Others involve the skeletal muscles, especially those of the face. Facial responses will be discussed in some detail in a later section dealing with emotional expression.

DIRECT ACTION

An emotion may result in some kind of direct action. Depending upon the emotion and the target, of course, the action may differ from situation to situation. One who is all of a sudden overwhelmed by a feeling of affection for someone he is with may express that affection directly (hugs, kisses etc.). A feeling of hostility, on the other hand, may result in provocative arguments and perhaps even overt attack.

The attack need not be against the most appropriate target, particularly if such a target might attack in return (such as when there is a conflict between hositility and fear of punishment). It may be *displaced*—directed against some other target that is more or less like the original one. Suppose, for example, that a man is sharply criticized by his boss. The emotional state resulting from the criticism may include hostility at the unfairness of the criticism. Rather than attack the boss, however, which might lead to the loss of his job, the employee goes home and gets into an argument with his

wife over a trivial matter. Direct action is involved, but it is in this case displaced to another target. Displacement is usually considered to be a defense mechanism, like denial, etc., discussed earlier.

FIXATION

Sometimes the behavior generated in response to frustration may continue in spite of the fact that it is incorrect and does not lead to reinforcement. Such a persistent response is called a *fixation,* and fixations have been shown to occur both in humans and in animals.

A number of years ago N. R. F. Maier at the University of Michigan showed that rats, given an insoluble problem in the Lashley jumping stand (see Figure 14.6) would, if forced to jump (by an electric shock applied to the starting platform), tend to respond to the stimulus card on one side of the apparatus and ignore the other side. This behavior persisted even when the rules were changed and the problem was made soluble. In other words, once the fixation developed, the animals were no longer able to take advantage of the information they got when the problem *was* soluble.

Emotional Communication

A major aspect of emotion is the information that is communicated to another individual (usually, but not necessarily, a member of the same species). A cat with its hair fluffed up and its ears laid back serves fair warning to other animals not to come too close. A human being may communicate his emotional state by words, facial expressions, or gestures. Careful study of nonverbal emotional communication may provide the basis for understanding better the ways in which we are related to other animals, and careful study of verbal emotional communication should provide some insights into the uniquenesses of human beings in contrast with nonverbal creatures. Neither of these areas is very well developed at present, but you will become acquainted with some of the recent thinking and research in each.

Verbal Communication

Most of us are not very good at describing our emotional states. The words just never seem to do justice to the feelings. This is the poet's standard lament, and a good one usually winds up expressing feelings by the use of metaphor and simile. He says, "I feel as if . . ." or "It's like a . . ." A person who is good at this can communicate exquisitely subtle emotions, while most of us just stammer along.

One of the problems in verbal communication of emotions is that our language is for the most part an object language. It is very good at describing external objects as well as abstract relationships between them. However, it is not geared to describe emotional experiences with the same nuances. At the same time, people do manage to stay somewhat in touch with one another emotionally, and this contact is at least partly verbal. How do we manage?

Joel Davitz (1969), whose work was mentioned in the first section of

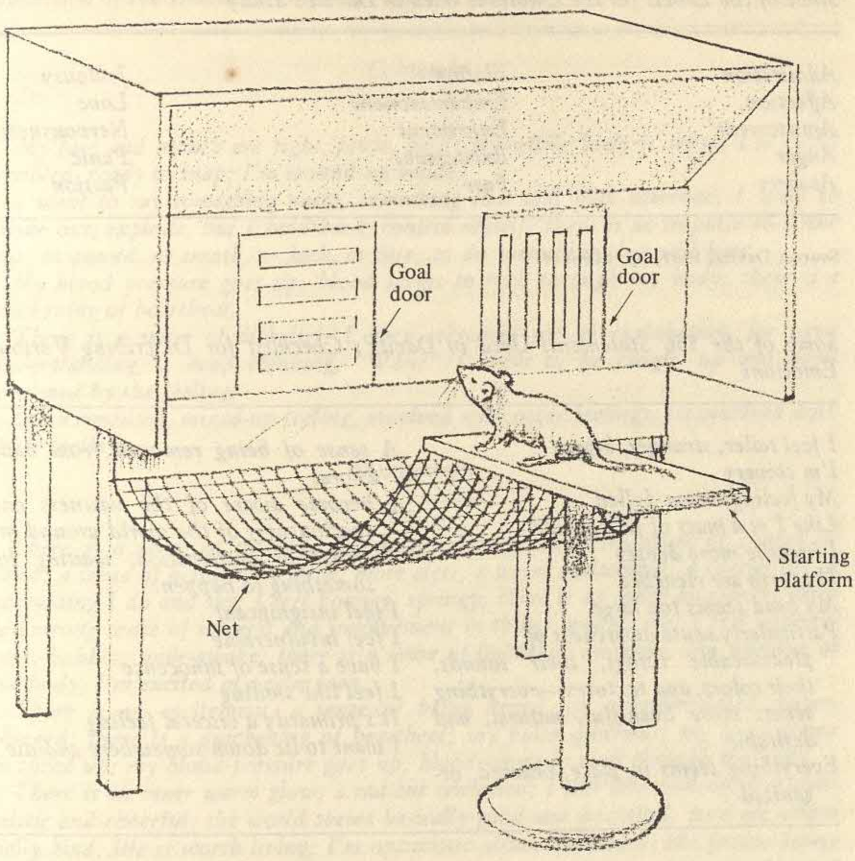

FIGURE 14.6

A Lashley jumping stand. Maier, in his experiments on frustration, used such an apparatus. The animal is trained to jump from the platform to one of the two doors, which is unlocked. The incorrect door is locked, and jumping at it will result in a sore nose and falling into the net below.

this chapter, has attempted to find out how people communicate emotions verbally, and to develop a dictionary of emotional meanings.

To begin with, he selected from *Roget's Thesaurus* 50 terms that seemed to represent a wide variety of emotions. Some of these words are shown in Table 14.3 He also devised a long checklist, containing 556 items that could be used to describe emotional experience. Some of these items are shown in Table 14.4 Then he had 50 subjects imagine a situation in which he had experienced each one of the 50 emotions and, going through the checklist, indicate which of the experiences described in the list applied to that emotion. This is obviously a monumental task from the point of view of the subjects: each subject had to spend about 25 hours to complete it.

From the mass of items checked as applying to each emotion, Davitz derived a set of definitions, one for each of the 50 words. Two of the definitions are shown in Table 14.5. You will recognize some of the statements

TABLE 14.3 *Some of the Labels for the Emotions Used in Davitz's Study*

Admiration	*Elation*	*Jealousy*
Affection	*Embarrassment*	*Love*
Amusement	*Enjoyment*	*Nervousness*
Anger	*Excitement*	*Panic*
Anxiety	*Fear*	*Passion*

Source: Davitz, 1969, pp. 116–118.

TABLE 14.4 *Some of the 556 Statements Used in Davitz's Checklist for Describing Various Emotions*

I feel taller, stronger, bigger	*A sense of being removed from daily chores*
I'm shivery	*I become aware of the vastness and spaciousness of the world around me*
My feelings seem dulled	*A sense of anticipation, waiting for something to happen.*
Like I'm a mass of jelly inside	*I feel insignificant*
I breathe more deeply	*I feel invulnerable*
My teeth are clenched	*I have a sense of innocence*
My head seems too large	*I feel like smiling*
Particularly acute awareness of pleasureable things, their sounds, their colors, and textures—everything seems more beautiful, natural, and desirable	*It's primarily a visceral feeling*
Everything seems in place, ordered, organized	*I want to lie down somewhere and die*

Source: Davitz, 1969, pp 15–31

in the definitions from Table 14.4. The whole 50-word dictionary can be found in his book, *The Language of Emotion* (1969). What it gives basically is a set of descriptive terms that are presumed to be what most people mean when they use a particular emotional label, such as "I feel solemn today."

Recall from the previous discussion that Davitz grouped the subjects' judgments into four factors: activation, relatedness, hedonic tone, and competence. These factors of emotional meaning do not seem to be too different from those which Osgood (1952) has suggested make up the semantic meaning of all words. Osgood's technique, the Semantic Differential, has been described previously (Chapter 10). Recall that a subject rates a word on several scales such as short-tall, strong-weak, quiet-noisy, etc., and that these data may then be related to what Osgood considers to be the three dimensions of meaning: activity, evaluation, and potency. It is interesting that Osgood's technique uses primarily metaphorical meaning (i.e., in what way is the word *polite* strong or weak, good or bad?), while Davitz's technique asks subjects to indicate the extent to which a particular emotion is

TABLE 14.5

Definition of the Emotions Contempt and Excitement

Contempt
My face and mouth are tight, tense, hard; my whole body is tense; I'm easily irritated, ready to snap; I'm wound up inside.
I want to say something nasty, something that will hurt someone; I want to strike out, explode, but I hold back, control myself; there is an impulse to strike out; to pound, or smash, or kick, or bite; to do something that will hurt.
My blood pressure goes up; blood seems to rush through my body; there is a quickening of heartbeat.
There is a sense of disbelief; I keep searching for an explanation, for some understanding; I keep thinking, "Why?" I seem to be caught up and overwhelmed by the feeling.
It's a confused, mixed-up feeling, involved with other feelings; its involved with other feelings.
Excitement
There is a sense of vitality, aliveness, vibrancy, an extra spurt of energy or drive; a sense of being more alive; more alert; a warm excitement; a special lift in everything I do and say; I feel bouncy, springy; there is an inner buoyancy; there is a strong sense of interest and involvement in things around me; I feel effervescent, bubbly; wide-awake; there is a sense of lightness, buoyany, and upsurge of the body; I'm excited in a calm way.
There is an excitement, a sense of being keyed up, overstimulated, supercharged; there is a quickening of heartbeat; my pulse quickens; my body seems to speed up; my blood pressure goes up; blood seems to rush through my body.
There is an inner warm glow; a radiant sensation; I feel like smiling; I'm optimistic and cheerful; the world seems basically good and beautiful; men are essentially kind; life is worth living; I'm optimistic about the future; the future seems bright.
I keep thinking how lucky I am; I feel expansive; my movements are sharper and quicker.
There is a sense of being gripped by the situation; I seem to be caught up and overwhelmed by the feeling.
There is a sense of anticipation, waiting for something to happen; I feel outgoing; I'm wound up inside.

Source: Davitz, 1969, pp. 42–43, 54.

experienced in a particular way. While Davitz's approach is more closely joined with direct experience, and Osgood's is more abstract, they seem to yield quite similar end results. If two different techniques have similar answers, then perhaps we really can communicate emotionally, after all.

Nonverbal Communication

Much of the emotional communication between animals does not involve the use of words; i.e., it is nonverbal. Communication is accomplished by means of facial expressions, gestures, and nonverbal sounds. As such, it is quite difficult to analyze, powerful though it may be in terms of its impact

Pupil Dilation: an Outward Index of Emotional Response

The pupil of the eye is under control of the autonomic nervous system. The sympathetic system dilates it, while the parasympathetic system constricts it. Although its main function is to regulate the amount of light entering the eye, it appears to be responsive to activity in the autonomic nervous system coming from other sources. This seems to be the case at least for the dilation response to sympathetic activity. In other words, the pupil can be made to dilate not only in response to darkening, but also in response to emotional stimuli and intellectual activity.

Eckhard Hess at the University of Chicago showed in several experiments that subjects would exhibit pupil dilation when they were presented with stimuli that were pleasant or that aroused their interest. Hess also suggested that unpleasant stimuli caused the pupil to constrict, but this finding has been seriously questioned by other investigators. With regard to dilation, however, it was shown that the stimuli presented did affect the response. Hess and Polt (1960) showed various pictures to male and female subjects and measured the pupillary response. They found that females had more pupil dilation when shown a picture of a baby, a mother and baby, and a male nude; while male subjects had more pupil dilation when shown a picture of a female nude.

In another study Hess (1965) noted that a photograph of a female was more attractive to males when she was depicted as having eyes with large pupils rather than small ones. It is interesting to note that the drug belladonna (meaning "beautiful lady") was used for centuries by women to make their pupils larger (belladonna inhibits action in the parasympathetic system, thus shifting the balance of activity toward the sympathetic side, and dilation), presumably because it made them more attractive to men. In other words, it is possible that the pupil size can serve as an indicator of the state of the sympathetic nervous system and, indirectly, of the emotional response to particular stimuli.

There is one problem with much of this research, and it seems to be almost insoluble: the pupillary response to light and the response to the emotional attributes of visual stimuli are hopelessly confounded. The reason should be clear. The problem is: How do you know, when a subject is looking at a picture or other visual stimuli consisting of many areas differing in lightness, how much of his pupil response is caused by different amounts of light entering the eye from looking at different parts of the picture, and how much is due to the emotional message? The answer is that you do not know, unless the subject rigidly maintains fixation on a single point within the picture, which is a very difficult task.

It is clear that for research purposes, visual stimuli are inappropriate. On

the other hand, at least some of the studies using other stimuli, e.g., auditory stimuli, have shown dilation in response to emotional stimuli. Thus it is possible that at least in some situations, pupillary dilation can be taken as an index of the emotional value of certain stimuli.

upon other organisms. Much of the recent work in emotional expression has investigated the role of facial expressions, and our discussion will for the most part be limited to this topic.

Are there universal patterns of emotional expression that are recognized by all men, regardless of the culture to which they belong? This question has been raised and answered from time to time for a long time. The main issue, as usual, has been whether the relationship between a particular emotional state and the expressive movements, particularly of the face, is something that is "built in" to the genetically determined program of action of an individual or whether the pattern of expression is one that is primarily learned. If the latter is the case, then different patterns of expression would presumably be characteristic of different cultures, whereas the former position would imply certain universals in expression, regardless of culture.

The first position was advanced strongly by Charles Darwin in a monumental work entitled *The Expression of the Emotions in Man and Animals,* which was first published in 1872. Darwin argued that many of the emotional expressive movements in man and animals were the product of biological evolution and, therefore, were inherited.

As an example of the way in which Darwin thought emotional expression evolved, consider the expression of disgust or contempt, which is often expressed by a wrinkling of the nose and a curling of the upper lip. These same reactions are encountered in response to a bad smell, and occur in many animals. Their function in the expression of contempt or disgust, Darwin thought, derives from presumed similarities in the state of mind generated by a bad smell and a disgusting situation.

> Extreme disgust is expressed by movements round the mouth identical with those preparatory to the act of vomiting. The mouth is opened widely, with the upper lip strongly retracted, which wrinkles the sides of the nose, and with the lower lip protruded and everted as much as possible. This latter movement requires the contraction of the muscles which draw downwards the corners of the mouth (1965, pp. 257–258).

Darwin goes on to say,

> From the answers received from my correspondents it appears that the various movements, which have now been described as expressing contempt and disgust, prevail throughout a large part of the world (1965, p. 259).

In this manner Darwin argued that many of the characteristic emotional expressions are components of biologically adaptive reactions to *real* stimuli which bear some similarity to the stimuli that produce the emotional state. The original reactions may or may not still be present in the animal's repertoire of behavior, depending upon the circumstances of evolution. Their vestiges, however, remain in the automatic emotional expressions such as smiling, frowning, etc. Since the expressions presumably evolved before the various races of man became separated, they are universal.

Other writers deny the existence of innate forms of expression and attribute the existing forms to particular patterns of social learning. For instance, Otto Klineberg (1938) points to differences between Chinese and Western facial expressions, as described in Chinese literature, and argues that they must be learned as a part of the socialization process. Furthermore, several experiments have shown that observers have difficulty in interpreting the emotions of faces made by actors without having some knowledge of the context in which the face was made. Thus the alternative position, also espoused by a number of other investigators, is that universal forms of emotional expression do not exist at all, and that the form of expression for a given emotion is quite flexible, depending upon how one learns to express it through imitation and attempts at communicating with members of his culture.

How is the issue to be resolved? Paul Ekman (1971) has suggested that both positions may be right in some sense. He argues that a particular form of emotional expression results from the operation of two different processes. First of all, there is what he calls a "Facial Affect Program," which consists of a set of innate "rules" for producing particular facial expressions in response to particular emotional states such as happiness, anger, surprise, disgust, fear, sadness, and interest. These same rules, his theory asserts, are present in all men, regardless of their culture. (Note the similarity between this approach and the approach to language of transformational grammar developed in Chapter 10. In both approaches behavior is explained with reference to internal rules.) The expression of the rules, however, is modified by means of particular forms of cultural learning. Cultural learning would specify when, for instance, joy or disgust, or anger, etc., could be displayed as well as the various ways to *mask* the more direct forms of expression of these emotions. For this reason the actual facial expression may not, therefore, be the same from culture to culture. Expression of a given emotional state may be changed by intensifying or weakening the state, by neutralizing it, or through masking, i.e., adopting the facial expression of a conflicting emotion. Anger at your boss's criticisms of your work habits may best be masked or neutralized, a process that would show up in your facial expressions. The reason is obvious. Direct expression via the facial affect program would, you have learned, probably result in your getting fired.

Another point at which learning can enter the picture is in establishing the situations that elicit a particular emotion. Funerals may provoke sadness or joy, depending upon what you have learned is an appropriate emotion for the situation. Taking a quiz may be the occasion for fear and anxiety,

or for eager anticipation, depending upon what you have learned about quizzes.

Because of these two cultural factors--the establishment of particular display rules and definition of the proper relationship between particular situations and the appropriate emotions to be experienced—Ekman argues that it is quite unlikely that observers would be terribly accurate in judging the emotion experienced by a subject without knowing the context in which the expression was produced. That fact, however, does not negate the idea of a universal "program" for expression. It simply makes it more difficult to observe.

How does one go about demonstrating cross-cultural similarities in emotional expression? Actually, the task is a formidable one. For a beginning, Ekman and his associates inquired whether American and Japanese subjects could accurately determine whether an American or a Japanese individual was viewing a "neutral" or a stressful movie. If there is a universal pattern of facial expression in the stressful situation, then this fact should enable observers to judge which movie was being watched, regardless of the culture. On the other hand, if the expression and recognition of emotional states were mostly culturally dependent, Japanese subjects should be better at judging Japanese, and Americans at judging Americans. In any case all the subjects had to go on was a movie of the facial expressions of the viewer, taken while he was viewing one of the two movies.

The outcome of the experiment offered some support to the universalist view since, as it turned out, the subjects were no better able to judge a member of their own culture than a member of the other culture. They were, however, able to judge correctly, at a level that was slightly better than chance, which movie the subject was watching.

The next step was to describe the facial expressions of the viewers, determining the extent of similarity between the Japanese and Americans viewing a given movie. The method was too intricate to describe here but involved systematically observing different parts of the face (eyebrows, eyes and lids, and lower face) for the presence or absence of particular movements. For example, they noted whether the eyebrows were raised or curved, raised and drawn together, pulled down and inward, or drawn down and separated. These four different expressions were presumed to represent the emotions of surprise, fear, anger, and disgust, respectively. These four emotions, together with sadness and happiness, were the six emotions upon which they focused, using a collection of facial features thought to be characteristic of each. They found that when they scored the movies of the viewers for these particular facial features, there was a high degree of relationship between the American and the Japanese viewers.

In order to rule out the possibility that the correlations were a result of the cultural communication between Japanese and Americans through television, movies, travel, etc., they made another study with preliterate tribesmen in New Guinea who had had little or no contact with Westerners or with Japanese. They found that these subjects were able to recognize in many cases the emotion expressed in photographs of Westerners. Thus the

amount of previous contact with a culture does not seem to be a critical factor.

To summarize briefly, there is presently a great flurry of research activity on the communication of emotions, both verbal and nonverbal. It seems clear that at least in English, individuals do tend to use a given set of emotional labels consistently and that the wealth of emotional information contained in the various labels can be organized along three or four basic dimensions of meaning. There is also evidence that individuals of different cultures tend to use similar facial expressions to express a given emotion, although the existence of learned differences in the situations eliciting a given emotion and in the way in which basic emotions are altered for reasons of social appropriateness makes analysis of this problem quite difficult.

Emotional Development

Obviously, infants do not begin life capable of expressing the subtle and varied emotions that adults routinely display. On the other hand, the establishment of a two-way emotional bond between mother and child is generally thought to be of utmost importance in the socialization process. Some investigators, such as Bowlby (1969), believe that absence of the mother or an acceptable substitute during the second half of the first year of life can have serious consequences for the later emotional development of the child, not to mention the anger that it produces at the time. Whether it is the *absence* of the mother or her withdrawal in certain situations that is most important remains to be seen.

What is the basis for this capacity to communicate emotionally? How does it develop? There are really two parts to the question, one of which concerns the development of the ability to express various emotions, the other the development of the capacity to recognize emotional expressions in others. These two parts of the problem will be discussed separately in the following sections.

Emotional Expression

The reference study for the development of emotional expression is still that of Bridges, who published her work in 1930. She noted that the newborn's apparent emotional expression varies on only one dimension—that of excitement. In other words, he is sleeping, calm, or excited, but there is not any differentiation of, say, fear, anger, etc., as yet. Within a month or so, however, out of general excitement there differentiates a distinct distress reaction, and soon after that a positive emotional counterpart that Bridges labeled *delight*. These basic positive and negative emotions in turn differentiate further, according to the pattern shown in Figure 14.7. Note that by the age of 2 years, there is a relatively sophisticated repertoire of emotions to be expressed.

What is the basis for this pattern of development? While the question has not been subjected to as much study as it might have, it would appear

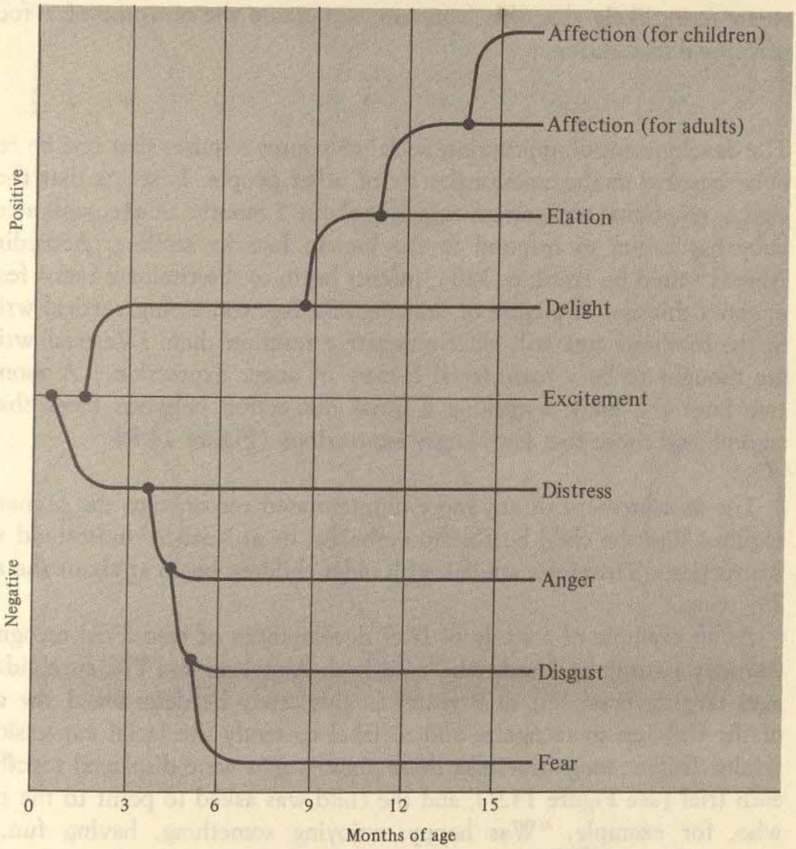

FIGURE 14.7 *The course of emotional delevopment, according to Bridges (1930). Note that all emotions develop out of a general excitement and, by 15 months of age, the infant's repertoire of expressions is rather detailed. From Bridges, 1930.*

that maturation of the neuromuscular structures necessary for the more differentiated forms of expression plays a major role (Izard, 1971). Consider the response of smiling, for instance. It begins to appear at about the fourth or fifth week of life. While smilelike movements may occur earlier, the social response—smiling in response to a human face—does not appear until that time. The time at which this response appears seems to be relatively constant across individuals, suggesting that a maturational factor is involved. (See Chapter 6 for a more detailed discussion of the later development of this response.)

Fear, another prominent emotion, takes longer to develop. Up until about the age of 6 months, the infant is fearless. He may become distressed in the presence of pain, but fear is not apparent. At about 9 months of age, fear of strangers seems to develop rather uniformly, whereas up to that time the infant is usually rather indiscriminate in his reactions to people. It would be hard to argue that such fear developed because of negative conditioning; it

seems more likely that this fear, too, represents the outcome of a form of perceptual maturation.

Emotional Perception

The development of appropriate social responses requires that one be reasonably sensitive to the emotional state of other people. It seems that the first sign of emotional recognition comes at about 5 months of age, well after the baby has begun to respond to the human face by smiling. According to Ahrens (cited by Izard, p. 320), infants begin to discriminate facial features at about this age. A picture or drawing of a face containing vertical wrinkles in the forehead area will elicit a negative reaction then. (Vertical wrinkles are thought to be a basic facial feature of anger expression.) A month or two later the baby is making a gross distinction between faces that are smiling and those that have angry expressions (Figure 14.8).

The measurement of any more differentiated response to the human face requires that the child be able to verbalize, or at least to understand verbal instructions. Therefore, studies with older children begin at about the age of 2½ years.

As an example of a study of later development of emotional recognition, consider a study by Izard, who used both American and French children of ages ranging from 2½ to 9 years. In this study he determined the ability of the children to recognize and to label correctly the facial expressions of adults. In the recognition task three photographs were displayed together on each trial (see Figure 14.9), and the child was asked to point to the person who, for example, "Was happy, enjoying something, having fun, very happy." The ability to point to the correct picture would indicate the ability, in this case, to recognize the expression of excitement and joy. In the labeling the children were asked to describe what the person depicted was feeling.

Izard found, as you might expect, that the number of correct recognitions increased with age, and the American and French children performed at about the same level (see Figure 14.10). With regard to recognition of specific emotions, anger and joy were recognized at an earlier age than the others, while contempt and scorn were the last to be recognized.

The ability to label the emotions correctly also increased with age, but, perhaps surprisingly, the American children developed this ability earlier than the French children. These findings are also shown in Figure 14.10. Izard suggests that maybe the reason why the French children develop this ability more slowly is that they are more sheltered from adult emotions at the earlier ages.

In general, then, studies of emotional development are congruent with the developmental principles elaborated in Chapter 3, in that the progress is toward a more differentiated ability both to recognize and respond appropriately to emotions. Furthermore, at least at the earlier ages, maturation seems to play a major role.

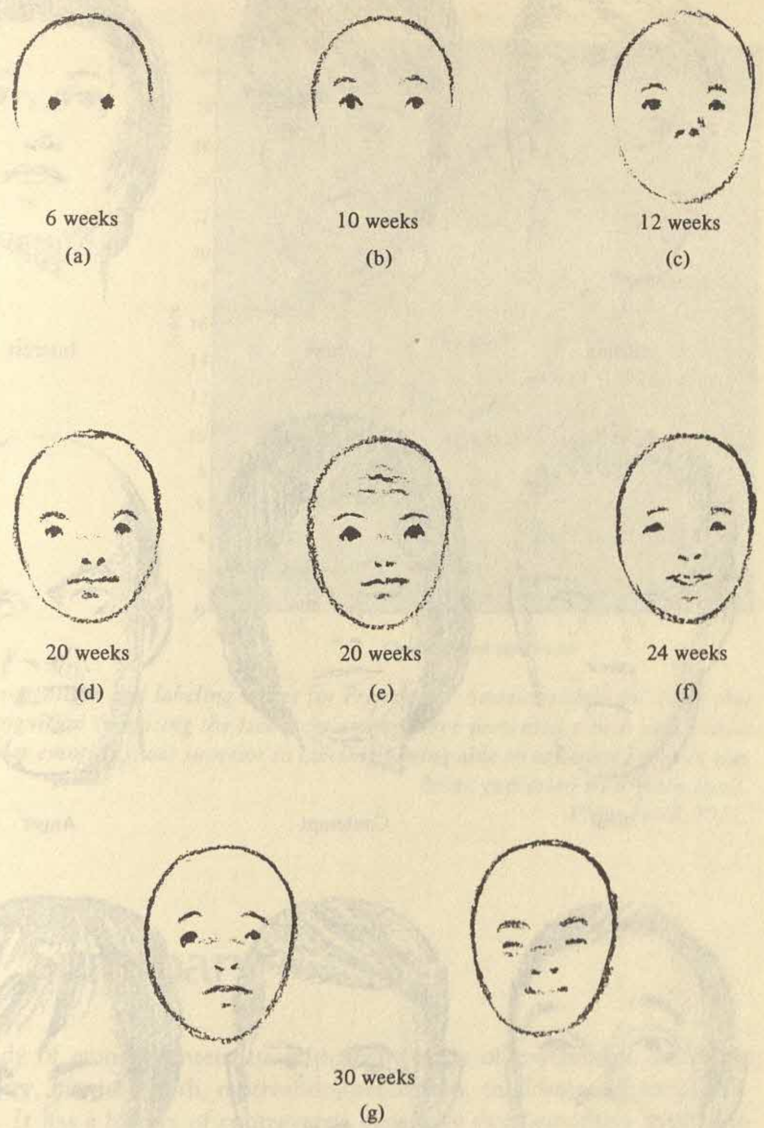

FIGURE 14.8

The development of emotional responsiveness to the human face. (a) At about 6 weeks of age, simple lines and angles will elicit smiling. (b) At 10 weeks, the eyes alone will suffice for smiling. (c) At 12 weeks the lower part of the face must be present for smiling, although the mouth is still unimportant. (d) At 20 weeks the mouth and its movements become more important, with a wide mouth being best for eliciting smiling. At this same age wrinkled brows and stylized eyes (e) will evoke turning away. (f) By 24 weeks of age the eyes become less effective, and mouth movements become more important. (g) By 30 weeks individual facial expressions begin, and generalized features become less effective.
Ahrens, 1954, as reported by Gibson, 1969.

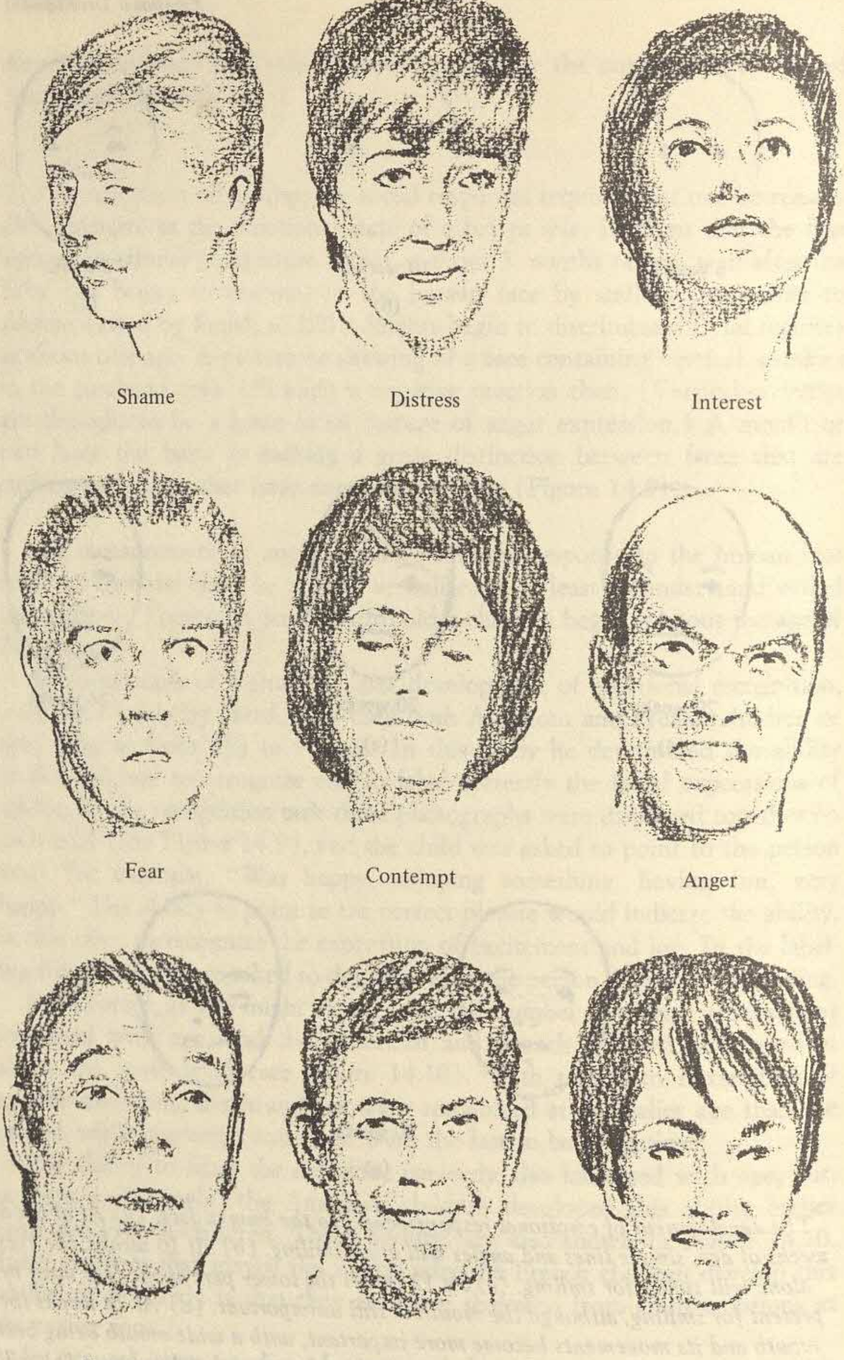

FIGURE 14.9 *Drawings of the photographs used by Izard in his study of emotional recognition and labelings in children. In the labeling task, the subject had to indicate which emotion was being portrayed, while in the recognition task, he was shown three faces and had to indicate which one of the three was displaying a given emotion. From Izard, 1971.*

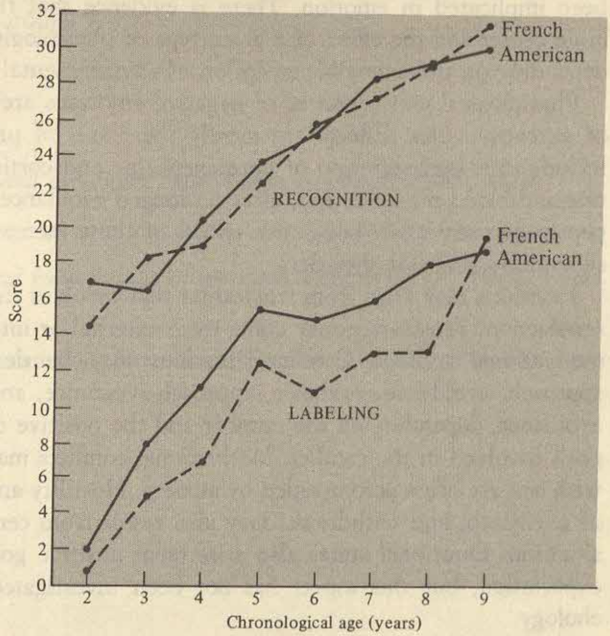

FIGURE 14.10

Recognition and labeling scores for French and American children. Note that recognition (choosing the face from among three presented which expressed a particular emotion) was superior to labeling (being able to say what emotion was being expressed by a given face). From Izard, 1971.

Summary

The study of emotion intersects with many areas of psychology, including personality, mental health, motivation, perception, thinking, and social psychology. It has a history of controversy, especially since emotions have been considered as acting in opposition to rational thought.

An emotional state may be regarded as a set of *feelings,* as a response to the perception and appraisal of situations of personal relevance, as a strong form of *motivation,* and as a *physiological state* involving activity in various parts of the nervous system. Assessment of the number of different emotional states varies from investigator to investigator, and several schemes have been devised for categorizing these states.

There are several different ideas about the physiological basis for emotion. Various centers in the limbic system and thalamus, hypothalamus, and midbrain have been implicated in emotional expression and experience. Perception of the bodily consequences of physiological arousal, including autonomic effects and postures and gestures involving the skeletal muscles, have also

been implicated in emotion. There is evidence that the action of a given brain center and the effect of a given type of physiological arousal may vary, depending on the animal's perception of environmental circumstances.

Physiological consequences of negative emotions are studied by the field of psychosomatics. Effects are mostly the result of prolonged arousal and include increased secretion of norepinephrine and cortisone, increased heart rate and blood pressure, and, after prolonged avoidance situations, increased pepsinogen secretion. Long-term effects of these increases include hypertension, ulcers, and skin disorders.

Emotions may arise from frustration that involves the blocking of motive satisfaction. Frustration may come from external or internal causes, or from motivational conflict. Conflict situations may be described as approach-approach, avoidance-avoidance, approach-avoidance, and multiple approach-avoidance, depending on the number and the positive or negative quality of goals involved in the conflict. Motivational conflicts may be difficult to cope with and are often accompanied by anxiety. Hostility and aggression, feelings of alienation, and withdrawal may also result from certain types of conflict situation. Emotional states also arise from positive goal attainment and its expectation, but this aspect has not been investigated very much in psychology.

Emotional responses may also accompany the cognitive appraisal of a situation, particularly if the appraisal involves a perceived threat. Appraisal is a continuing process, however, and reappraisal may produce a different emotion. Cognitive rehearsal of emotional experiences may serve to reduce the negative impact of a threatening situation. Cognitive consequences of emotion include realistic thinking and planning as well as various forms of distorted thinking. Distortions include denial and repression, rationalization, and projection, all of which prevent anxiety-provoking motives from coming into awareness, and which may also serve to enhance self-esteem.

Behavioral effects of negative emotions include preparation for fight or flight, aggression or other direct action, and indirect action against a substitute goal (displacement). Fixation, whereby an ineffective response is tried over and over again may also occur.

Emotional states are communicated to other animals through verbal and nonverbal means. Recent research has led to the development of a dictionary of emotional meaning as well as to increased recognition that subjective emotional states can be dealt with in a reasonably systematic manner. Recent studies of nonverbal communication have focused upon the possibility that there are cross-cultural, universal patterns of facial expression for the various emotions, and results tend to confirm this idea.

The development of emotional expression and the ability to recognize emotions in another person involves increasing differentiation. Emotional expressiveness begins with the dimension of general excitement; the other emotions, beginning with distress and delight, emerge with increasing age. The recognition of emotions in others is focused on the face, and by 8 or 9 months the infant can differentiate happy from angry faces. Verbal labeling

and relating verbal expressions to facial expressions develops continuously from about age 2½ through 9.

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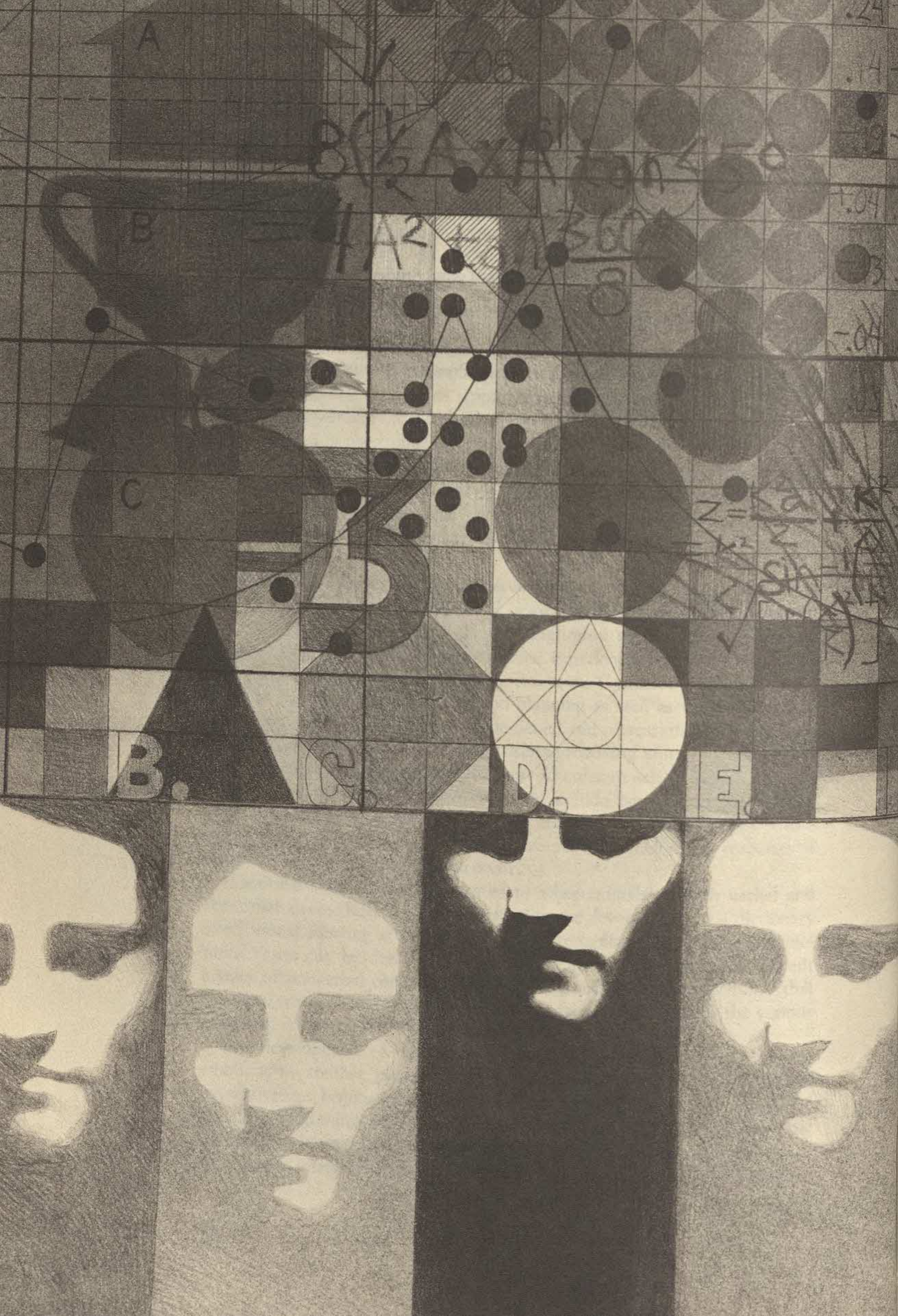
A
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Intelligence

15

Introduction

Why does one student make A's, while another has great difficulty in making C's, and yet another seems to have trouble understanding anything of what's going on at school? Some people find mathematics easy, while others blanch at the sight of a formula. Reading is learned with the greatest of ease by one child, while another one just cannot seem to get it. Some individuals seem to have a knack for making money on the stock market, while someone else's investments just do not seem to pan out. On the other hand, some people seem to be good at almost everything they attempt, while others have a great deal of trouble finding something that they are good at. Many of us just plug along, not doing exceptionally well or exceptionally poorly, managing to get by. There are professors who have difficulty discriminating a piston from a hubcap, master mechanics who cannot tell a metaphor from a simile, and janitors who write poetry.

The range of individual differences is, as you are no doubt aware, quite broad, and much of the variability between individuals seems to be relatable to differences in intelligence, aptitudes, and, in general, capabilities or capacities. The concept which has been applied most widely to the kinds of individual differences described above is that of *intelligence.* This concept has been one of the more controversial ones in psychology, and there are still several different points of view about it. In this chapter four different aspects of the problem will be considered. First of all, you will see something of the history of the concept, including the evolution of current meanings. Second, the problem of measurement of intelligence will be discussed, and several current methods will be described. Third, some of the broader implications of individual differences in intelligence will be elaborated. Of especial interest here are extremes in intelligence—the gifted and the retarded. Finally, the question of the sources of individual differences in intelligence will be considered. The debate between advocates of hereditary and environ-

mental bases is of long standing and is still current, and therefore must be dealt with.

The Concept of Intelligence

The history of interest in intelligence is long or short, depending upon how you look at it. Since the time of Plato and Aristotle the nature of the human mind, in particular, the *intellect,* which is the basis of rational thinking, has been considered in Western philosophy, and the sheer bulk of writings on this topic is unimaginable. From the short point of view, it was only in the last part of the nineteenth century that a serious interest in *individual differences* in intellectual ability began to emerge. This interest led to practical concerns with the measurement of intelligence, in particular, the development of intelligence tests. Although the question was by no means ignored, there was a relative lack of concern with the nature of that which was to be measured. Intelligence was whatever was required to do well in school, and a test that predicted success in school was therefore a good intelligence test.

These two roots—the practical and the philosophical—have led to somewhat different conceptualizations of intelligence. They have been termed the psychometric approach and the developmental, or structural, approach (Elkind, 1969). At this point in time both approaches are quite empirical, or based upon observation. That is, both are concerned with being able to elaborate the behavior that is a consequence of intellectual activity. Both approaches are also concerned with the broader question of the meaning of intelligence. The types of observations they stress, and the methods used to make those observations are, however, quite different, and derive mainly from their different histories.

ACHIEVEMENT AND APTITUDE

Before proceeding with this topic an important distinction must be made. The term *achievement* refers to an ability that an individual has learned or otherwise acquired. *Aptitude,* on the other hand, refers to one's *potential* for achieving. That is, a person may have the aptitude for learning to type but may not have acquired the ability, since he never tried to learn. A person with an aptitude for mathematics may not actually know much mathematics but would be expected to learn it easily when given the opportunity. An aptitude test, then, is used to predict the ease with which one may learn a particular skill, while an achievement test measures how much of that skill he has acquired.

Actually, however, one must have acquired certain skills in order to take most aptitude tests. Verbal ability, such as reading and following directions, is required for most tests, and an aptitude test is not a valid predictor for someone who has not acquired the skills that are assumed by the test. This fact has led to some rather controversial issues in connection with ethnic, particularly racial, differences in intelligence, which will be discussed later.

The Psychometric Approach

The term *psychometrics* means literally "measurement of the mind." In actual fact, however, the term refers to a branch of psychology concerned with problems of measurement and the prediction of behavior on the basis of that measurement. Sir Francis Galton, the British aristocrat, scholar, mathematician, and psychologist, was one of the first to take seriously the question of individual differences and their measurement, and is considered to be one of the founders of the psychometric movement. Galton was interested in the question of the origins of genius and thought that he could contribute to an understanding of this area, as well as to the problem of improving the race, by developing means for measuring human capabilities. He thought that simple factors such as the ability of the senses to make fine discriminations and the capacity to react quickly were the bases for intellectual ability, so he focused upon these kinds of measurements. As it turned out later, these kinds of abilities have little to do with intellectual aptitude. However, Galton's work did serve to promote interest in the questions, and he developed some statistical methods that have been used ever since.

Alfred Binet took a different view of intelligence. Binet, a Frenchman, was interested in devising a test to identify slow learners who would have difficulty in school. Together with a psychiatrist, Theodore Simon, Binet constructed the first intelligence test, which was published in 1905. Binet thought Galton's ideas about intelligence were much too simple and suggested that a comprehensive set of traits including memory, imagery, imagination, attention, comprehension, suggestibility, aesthetic appreciation, moral ideas, motor skills, and will power were all components of intellectual aptitude, and any test should include tests for these traits. His intelligence test, and the subsequent ones based on it (discussed in the following sections) employed this broad conception of intelligence.

The success of Binet's test and its offspring prompted a great deal of interest in the concept of intelligence and its measurement. There was much talk and writing about what intelligence "is," and many different tests were devised to measure it.

In the main, two points of view developed within the psychometric tradition. One of these, associated with the name of L. L. Thurstone (1938, 1941) maintains that intelligence is a collection of basic intellectual traits (Thurstone used the term *primary mental abilities*) that are independent of one another. A person who is good at mathematics may be poor at visualizing spatial relations, and vice versa. The traits Thurstone suggested and an indication of what each means are shown in Table 15.1.

The other point of view is associated with the name of C. Spearman (1927), who thought that in addition to several relatively independent mental abilities, intelligence consisted of a common factor that he named *g* (for general), which relates to all of the basic abilities; *g* included such capacities as the ability to learn, to generalize one's experiences, and to think abstractly. A person with a lot of *g* would tend to do well on all tests of abilities. This would not be so according to Thurstone's original view, since a high score on a test of one's ability would not necessarily be related to a

TABLE 15.1 *Thurstone's Primary Mental Abilities and Examples of Their Meaning*

Primary Ability	*Explanation or How Tested*
Verbal comprehension	*Reading comprehension; understanding analogies and proverbs; vocabulary*
Word fluency	*Rhyming; working anagram problems; generating words in a given category*
Space	*Perceiving geometric relations accurately; Visualizing transformations in geometric relations*
Associative memory	*Rote memory, particularly for paired associates.*
Perceptual speed	*Grasping details accurately, noting quickly similarities and differences*
General reasoning	*Finding rules governing particular sets of instances, as in completing number series*

Source: From Anastasi, 1968, pp. 329–330.

high score on a test of a different ability. Even Thurstone (1941), however, eventually came to the conclusion that specific aptitudes were supplemented by a general aptitude.

Both of these points of view have persisted into the present. Perhaps the most elaborate model in the Thurstone tradition is that proposed by J. P. Guilford (e.g., 1967), who advanced that intelligence is composed of 120 different factors. He divided them into three major categories: *contents* make up the material that intelligence works with, such as symbols or meanings; *operations* are what intelligence does with the contents, such as evaluation and memory; *products* are the outcomes and consist of such things as logical implications and relationships (see Figure 15.1).

The Spearman tradition is seen in the writings of investigators and clinicians interested in intelligence for purposes of diagnosis and guidance. They rely heavily upon tests of "general intelligence" and use the term as though it were a unitary phenomenon *à la* Spearman.

Evaluation of these two points of view hinges on some sophisticated statistical treatments that are beyond the scope of this book. However, they boil down to the question of whether individuals who score high (or low) on a test of one "factor" also tend to score the same on tests of other factors. In general, very few psychologists believe that the factors are completely independent of each other. Guilford's model, for example, does not assume that there are 120 completely independent aspects of intelligence. It is, however, useful to conceptualize these 120 factors as somehow different from one another, although one would certainly expect that individuals who do well on a test of one factor would tend to do well on tests of some other factors.

A third, less theoretically oriented position within the psychometric tradition is that "Intelligence is whatever the intelligence tests test." You

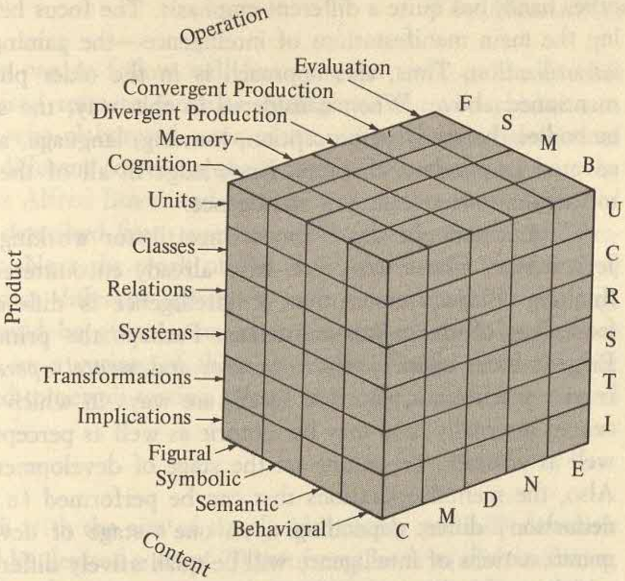

FIGURE 15.1

J. P. Guilford's model of the structure of the intellect. Visualize it as a three-dimensional solid, in which the major dimensions are contents, operations, *and* products. *Guilford identifies four kinds of contents upon which the intellect operates: figural (i.e., representations or patterns), symbolic (letters and numbers), semantic (words and other carriers of meaning), and behavioral (concerning other people's attitudes, behaviors, etc.). The operations are what one does with the contents, and the products are the outcome of the operations upon the contents. Since there are 4 contents, 5 operations, and 6 products, their combinations yield 4×5×6=120 different factors (one factor would be remembering (memory) semantic relations, i.e., remembering sentences). From Guilford, 1967.*

may find it hard to take this point of view seriously. However, it does go a little further than simply ignoring the problem of definition. It takes cognizance of the fact that intelligence tests are used primarily to predict success in school, and that success in school involves mnay different abilities and aptitudes. Thus it would perhaps be best to spend less time worrying about a priori definitions of intelligence and more time in trying to understand what lies behind success in school. Intelligence is thus defined as a score on an intelligence test, and the implications of such scores are to be determined by research. Attempts to define what intelligence "really is" serve merely to *reify* the concept (see Chapter 2), rather than relate it to observable behavior.

The Structural Approach

The hallmark of the psychometric approach is the intelligence test. Regardless of how the concept intelligence is interpreted, the focus is on the fact that individuals differ in various kinds of performance, and tests are important for predicting those differences. The structural approach, on the

other hand, has quite a different emphasis. The focus here is on understanding the main manifestations of intelligence—the gaining of knowledge and its utilization. Thus, this approach is in the older philosophical tradition mentioned above. When considered in this way, the study of intelligence embodies the study of perception, learning, language, and thinking—topics covered in previous chapters. Knowledge in all of these areas contributes toward an understanding of intelligence.

Without a doubt the foremost investigator working in this tradition is Jean Piaget, whose work you have already encountered in Chapter 11 on thinking. Piaget's conception of intelligence is different in several ways from that of the psychometricians. Perhaps the primary difference is in Piaget's focus upon *mental structures* and *mental operations.* Mental structures, or schemata, you will recall, are ways in which knowledge is represented internally, and may be motoric as well as perceptual, and concrete as well as abstract, depending on the stage of development of the individual. Also, the mental operations that can be performed (e.g., conservation and deduction) differ, depending upon one's stage of development. Thus the manifestations of intelligence will be qualitatively different, depending upon whether an individual is in the sensorimotor, preoperational, concrete operational, or logical operational stage.

Intelligence is conceived by Piaget as a manifestation of *biological adaptation.* It must have evolved to free the animal (in particular, the human) from being at the mercy of his instinctive behavior patterns, on the one hand, and transient variations in the environment, on the other. In other words, intelligence ensures a balance between the processes of accommodation, whereby mental structures are altered in response to changes in the environment, and assimilation, whereby new information is related to an existing mental structure. (See Chapter 11 for a discussion of these processes.)

Since the Piagetian view sees intelligence as being something different at different ages, it is not a single faculty that one gets more and more of as he grows older. It cannot be adequately described by a single score on an intelligence test. That is not to say that one could not construct a test to assess intellectual functioning in Piagetian terms, or, for that matter, that existing tests of intelligence do not contain items that are relevant to this point of view. The point is just that these concepts have not found their way into the vast majority of tests devised by the psychometrists.

In summary, the construct of intelligence has several different meanings. In the psychometric tradition it is related to a score on a test that predicts success in school, and is thought of as either a collection of independent aptitudes (Thurstone) or a collection of independent aptitudes combined with a common, *g*, factor related to all of the aptitudes (Spearman). In the philosophical, structuralist, developmental tradition represented by Piaget, it is conceived of as a biologically adaptive function manifested in different ways at different ages but culminating in adult logical thought.

The Measurement of Intelligence

This section and the one to follow will focus on the work of the psychometricians who devised tests to measure intelligence (i.e., to predict success in school) and who elaborated some of the differences in behavior of individuals making different scores on these tests. The major figure in the history of this area is Alfred Binet, and his approach to the measurement of intelligence will be described first, together with later developments stemming from his work. Next the work of David Wechsler will be described Wechsler thought that different aptitudes such as arithmetic reasoning, vocabulary, etc., should be given more attention and devised intelligence tests yielding scores on a variety of these aptitudes. Finally, several other tests, mostly designed to permit testing groups of people, will be mentioned briefly.

Binet-type Tests

BINET'S ORIGINAL TEST

Binet began his work with the aim of simply identifying mentally defective children. To this end he devised a set of 30 test items, such as discriminating between wood and chocolate, recognizing objects in a picture, and remembering a series of digits. Soon, however, he determined that a good test should do more than differentiate normal and retarded children; it should also say how a child does relative to his age peers.

MENTAL AGE

In 1908 Binet revised his test and organized it into a set of subtests, grouped according to age. A particular test was assigned to a given age level if it could be passed by 75 percent of the children of that age but not by younger children. By 1911 he had put the same number of tests at each age level and suggested that each test passed should contribute a certain number of months of mental age to the child's score. Since there were five tests at each age level, each test was worth 0.2 years of mental age.

The concept of mental age is a very important one. What is it? First of all, it is a score on an intelligence test. Instead of counting points for correct answers, units of age are counted. If you pass all of the items on the test up to the eighth-year level, and three of the five tests at the eighth-year level, then your mental age would be 8.6 years (8 years for all the tests up to age 8, and 0.6 years for the three tests at the eight-year level). Second, a given mental age is the average score on the test made by children of that chronological age. In other words, an average child whose chronological age is 8 years, 0 months, will obtain a mental age score of 8.0 years. Thus a mental age score tells you the age of the average child who makes the same score as a given child on the test. It is, then, a way of comparing a given child with his peers.

IQ

The next step, suggested by William Stern in the same year, was to express a child's score as a ratio of his mental age to his chronological age. This ratio was called the "mental quotient," a name later changed by Lewis M. Terman, an American psychologist, to the familiar "Intelligence Quotient,"

or IQ. Thus an "average" child will have the same mental age and chronological age, and the quotient will be 1.00. Multiplying this term by 100 yields an IQ of 100. A very bright child of chronological age 9.5 who has a mental age of 14.0 will have an IQ of approximately 147. In general, the formula for IQ is

$$IQ = \frac{M.A.}{C.A.} \times 100$$

where M.A. is the mental age, and C.A. is the chronological age.

THE STANFORD-BINET TEST

Binet's test caught on quite well. Its foremost proponent in the United States was Lewis M. Terman, who translated it into English, added a few tests, and standardized it for Americans. Terman's version was published in 1916 as the Stanford-Binet. This test was revised in 1937 and again in 1960, and is still quite popular. There are six tests at each age level above 5, so that each test counts 2 months of mental age. There are 12 tests for each of the younger years so that each test counts 1 month.

A DIFFERENT VIEW OF THE IQ

The formula for IQ given above works reasonably well for children, since it indicates how they have grown mentally relative to other children of their chronological age. Some difficulties, however, arise when the formula is applied to adolescents and adults. The problem is that mental growth rate, like physical growth, begins to taper off as the individual reaches adulthood. Thus mental age advances less rapidly than chronological age. Since the formula for IQ above assumes a constant growth rate in mental ability, use of actual chronological age in the denominator of the equation would lead to all adults' having below average IQ's. The older one got, the less would be his score! In the earlier forms of the Stanford-Binet this problem was resolved by treating all adults as though they had a chronological age of 16. This practice did not work out very well, however, so the 1960 version employs a different conception of IQ, called the *deviation IQ*.

When the test was standardized, scores were obtained from individuals in many different age ranges, including children at each year of chronological age but also including adults of various ages. The deviation IQ is calculated by comparing an individual's score with the scores obtained by people in his own age group. In other words, it is a measure of the *extent to which an individual deviates from the average score obtained by his age peers.* If his score is above the average for his group, then his IQ will be greater than 100. The exact value of the IQ depends on how far above average it is, and can be found with the use of tables provided for that purpose. For example, a person whose test score is at least as good as 85 percent of his age peers will have an IQ slightly more than 115. On the other hand, a person scoring no better than 15 percent of his age peers will have an IQ of a little less than 85. The percentile values for the range of IQ's (i.e., the percent of individuals whose IQ's fall below a given score) are shown in Figure 15.2.

Actually, the deviation IQ was first used in the adult intelligence test devised by David Wechsler, called the Wechsler-Bellevue Test, which was

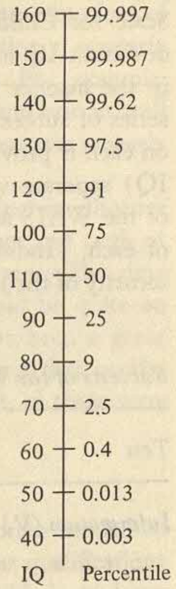

FIGURE 15.2 *The percentage of cases having IQ's below a given score. This figure is based upon the assumption that intelligence is normally distributed with a mean of 100 and a standard deviation of 15.*

published in 1939. Its popularity was one of the reasons that the most recent version of the Stanford-Binet adopted that scoring system. It is to Wechsler's tests that we shall now turn.

Wechsler's Tests

In addition to the problems encountered in calculating IQ's for adults, the Stanford-Binet test suffered another limitation, at least in the eyes of many psychologists. The problem was that only a single IQ score could be obtained. There was no way to produce a score that differentiated between various aptitudes making up intelligence. One could, of course, note qualitatively that certain kinds of tests seemed to be easy and others difficult, but such observations could not be compared with a standard sample of subjects, and, consequently, very little quantitative meaning could be obtained. Of particular concern was the differentiation between *verbal* aptitudes and *performance* aptitudes. Verbal aptitudes were thought to include logical reasoning and vocabulary, while performance aptitudes include perceptual-motor skills.

David Wechsler, a psychologist at the Bellevue Hospital in New York City, decided to construct a test that would (1) be more suitable for adults than the Stanford-Binet, and (2) provide a more differentiated picture of an individual's intellectual aptitudes than the single IQ score. The first test he devised was the Wechsler-Bellevue. In 1955 this test was modified and renamed the Wechsler Adult Intelligence Scale (WAIS). Shortly afterward

he devised a similar test for children, known as the Wechsler Intelligence Scale for Children (WISC). All three tests are similar in that (1) the deviation IQ is used, so that an individual is compared with his age peers in the manner previously described; (2) the overall test is composed of a series of subtests such as arithmetic, vocabulary, and reasoning, and a score on each is provided; (3) in addition to the overall IQ (called the *full scale* IQ) separate verbal and performance IQ's are provided. The 11 subtests of the WAIS are indicated in Table 15.2, together with a brief description of each. (Individual items cannot be shown, since that would violate the security of the test.)

TABLE 15.2 *Subtests of the Wechsler Adult Intelligence Scale*

Test	*Description*
Information (V)	*Questions covering topics that adults would presumably learned, and that would not require specialized academic knowledge.*
Comprehension (V)	*Questions as to what should be done in particular situations; proverbs; why certain practices are followed; in general, questions of practical judgment.*
Arithmetic (V)	*Problems, as in elementary school arithmetic, to be solved in one's head.*
Similarities (V)	*Questions asking how two items are alike.*
Digit span (V)	*Reproducing verbally a string of digits recited by the examiner, including tests for both forward and backward recitation.*
Vocabulary (V)	*Words are said and shown, and the examinee must say what each means.*
Digit symbol (P)	*Each of the nine digits is represented by a symbol, and the examinee must fill in blanks, giving the appropriate symbol for each digit given.*
Picture completion (P)	*Examinee must detect which part of several pictures is missing.*
Block design (P)	*The examinee must construct geometric designs, as instructed, from square blocks. The surfaces of the blocks are red, white, or red and white.*
Picture arrangement (P)	*Examinee must arrange cartoonlike pictures so that they tell a story.*
Object assembly (P)	*Objects must be assembled from parts, as in a jigsaw puzzle. Examinee does not know what the end product must be like, however.*

Note: (V) and (P) after the test names mean that the test contributes to the verbal (V) or the performance (P) IQ measure.

While it would seem that the 11 subtests would provide a great deal of information about a person's strengths and weaknesses, interpretation of subtest scores is limited by the fact that none of them, taken singly, is nearly as reliable as the verbal, performance, and full-scale IQ's. For example, an individual may score well on the arithmetic test one day and not so well on the next. However, his verbal and full scale IQ's would not vary nearly so much.

Both the Stanford-Binet and the Wechsler tests are *individual* intelligence tests. They can be administered to only one person at a time, and both of them require the services of a highly trained test administrator. The time required may be an hour or more, so as you can see, it could be quite an expensive proposition to take one. For this reason there has been a great deal of pressure to develop reliable and valid intelligence tests that can be administered to individuals in groups. We shall consider some of these tests in the next section.

Group Tests

When the United States entered World War I, the armed forces needed to assign large numbers of people to jobs based on their particular qualifications as well as to screen out those individuals who would be unlikely to learn any useful job. Several psychologists worked on the problem and devised the *Army Alpha* test. This test could be administered to individuals in large groups, and required some verbal and numerical skills in order to take it. Because some of the recruits could not read but were otherwise perhaps fit for the services, another test, the *Army Beta* test was devised. This test was a so-called nonverbal test, in that it did not require reading skills. Since that time the armed services have constructed and revised various tests. At present the Armed Forces Qualification Test is used by all services.

Other group tests of intelligence are available, one of the most popular being the Otis, developed by a psychologist of that name.

All of these tests are similar in that a single score is obtained. There are, however, several group tests that provide a more differentiated picture of intellectual aptitudes. One of these tests is Thurstone's Primary Mental Abilities Test, which provides a score on each of the scales described earlier in Table 15.1.

Tests of Specific Aptitudes

All of the tests above purport to measure "general intelligence." That is, they are designed to tap a wide range of aptitudes that are presumably required to do well in school. Even when a more differentiated picture is provided, as in the Wechsler tests, the aim is still to get a broad sampling of one's capabilities. There are, however, other requirements for tests. It may be necessary for a prospective employer, for example, to estimate the chances that an individual will be able to learn a particular job, which may or may not be related to general success in school. For this reason several tests have been devised, which are used for such specific purposes.

The U.S. Employment Service developed a test known as the General

Aptitude Test Battery, which consists of 12 different subtests, scores on which are relevant to the prediction of success in particular kinds of jobs. The College Entrance Examination Board (CEEB) tests, of which you are probably quite well aware, were designed to predict success in college work. Other tests have been devised to predict success in graduate school, medical school, dental school, law school, etc., and each is relatively specific for that purpose.

Statistical Aspects of Intelligence

In a group of 1000 individuals taken more or less at random, how many geniuses would you expect to find? How many would you expect to find who would have to be institutionalized because they cannot learn enough to take care of themselves? What does it mean to say that the "average" person has an IQ of 100? The first two questions are quite important if you are in the position of planning for the education of highly gifted individuals or for the care and treatment of mentally retarded people. In order to understand the answers, you need to know something about the distribution of intelligence in the population at large and some of the statistical concepts used to describe that distribution.

The Normal Distribution

Suppose that you gave an intelligence test to a large number of individuals, say 1000 of them, and then drew a graph which indicated how many individuals obtained each score on the test. The resulting graph is called a *frequency distribution* because it indicates the frequency of cases obtaining a particular score. The chances are good that unless you introduced some bias into the situation, such as testing only college students, your graph would look like the one shown in Figure 15.3. Notice that most of the cases have intermediate scores, while a few have extremely low and another few have extremely high scores. The overall distribution is shaped like a bell. Such a bell-shaped curve is called a *normal distribution, a normal curve of error,* or *a normal probability curve*. A large number of biological and psychological characteristics seem to be distributed in this manner. That is, the number of cases tends to pile up in the middle and taper off at the extremes.

The reason that the curve is shaped like a bell is as follows: For *any* characteristic that is presumably based on several or many different factors, it is assumed that some individuals will have many of those factors which are favorable for the characteristic, some will have none of the favorable ones and perhaps many of the unfavorable ones, while many individuals will have various combinations of favorable and unfavorable characteristics. For instance, if running speed is the characteristic of interest, some people (i.e., track stars) will have the right combination of neuromuscular coordination, heart and lung capacity, muscular strength, bony structure, and motivation, to do well. Others will have some but not all of those characteristics, while

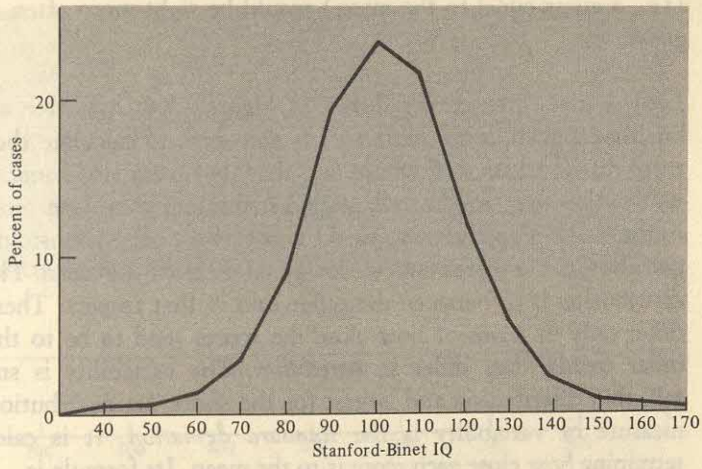

FIGURE 15.3

The actual distribution of intelligence, as measured by the Stanford-Binet test. Note that the distribution is approximately normal but with somewhat more cases in the lower half (i.e., below 100) than in the upper half. From Terman & Merrill, 1937.

still others will have none of them. Some of the factors are presumably developed through training, while others such as bony structure and perhaps coordination, are innate. It would stand to reason that few people will have all of the factors, or none of them, while most of us will have some combination. Consequently, some few individuals will run very slowly and a few will be quite fast; most of them will be intermediate in running speed. Precisely the same reasoning applies to the distribution of intelligence test scores.

The normal curve has a precise formula which we shall not discuss here. However, two characteristics of the distribution that are contained in the formula are important and should be understood. These two characteristics are the *mean* and the *standard deviation.*

THE MEAN

The mean is a measure of the average or typical score. It is found by adding up all the scores and dividing the sum by the number of scores that you added together. In terms of a formula, it is

$$\bar{X} = \frac{\Sigma X}{N}$$

where $\bar{X}$ (read "X-bar") is the symbol for the mean, X refers to an individual score, Σ is an instruction to add up all the individual scores, and N is the number of scores added up. The 1000 intelligence test scores that you hypothetically obtained above would probably have a mean of 100. If you were to select an individual at random from your set of scores, and had to guess what his score would be, your best guess would be 100. In other words, without knowing anything else about the individual, a guess of 100

(i.e., a guess equal to the mean) would be right more often than any other guess.

THE STANDARD DEVIATION

Look at the three curves shown in Figure 15.4. All three are bell-shaped, but they are also quite different. If you were to calculate the means of the three distributions, you would find that they were also equal. However, you will notice that, in the tall, thin distribution, there are more scores close to the mean than there are in the other two distributions. In the short, fat distribution the scores tend to deviate more from the mean. The intermediate distribution is in between the other two in that respect. These three curves differ only in terms of how close the scores tend to be to the mean, or, in other words, they differ in *variability*. The variability is smallest for the tall, thin distribution and largest for the short, fat distribution. A statistical measure of variability is the *standard deviation*. It is calculated by determining how close each score is to the mean. Its formula is

$$s=\sqrt{\frac{\sum x^2}{N}}$$

where s (or sometimes σ, the Greek sigma) is the symbol for the standard deviation; x (little x) is the difference between a given score and the mean (i.e., $x=X-\overline{X}$), $\sum x^2$ means to square each x and then add up the squares and N is the number of scores.

Once the mean and the standard deviation are known, a normal distribution is completely specified. That is, the relative number of cases obtaining any particular score is known. This idea is illustrated in Figure 15.5. Notice that for the distribution of IQ scores, the mean is 100 and the standard deviation is 15. Thus a person who scores 115 on an IQ test is one standard deviation above the mean (i.e., his score is 100+15), and is equal to or higher than

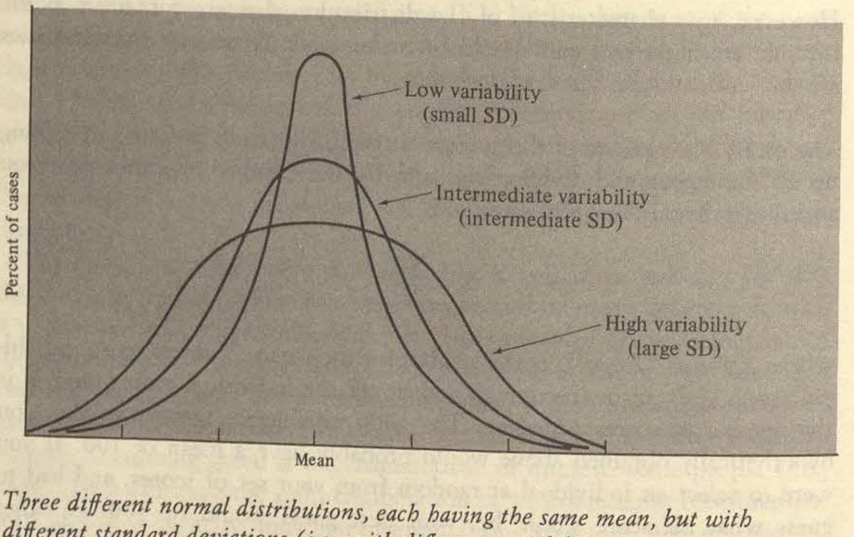

FIGURE 15.4 *Three different normal distributions, each having the same mean, but with different standard deviations (i.e., with different variabilities).*

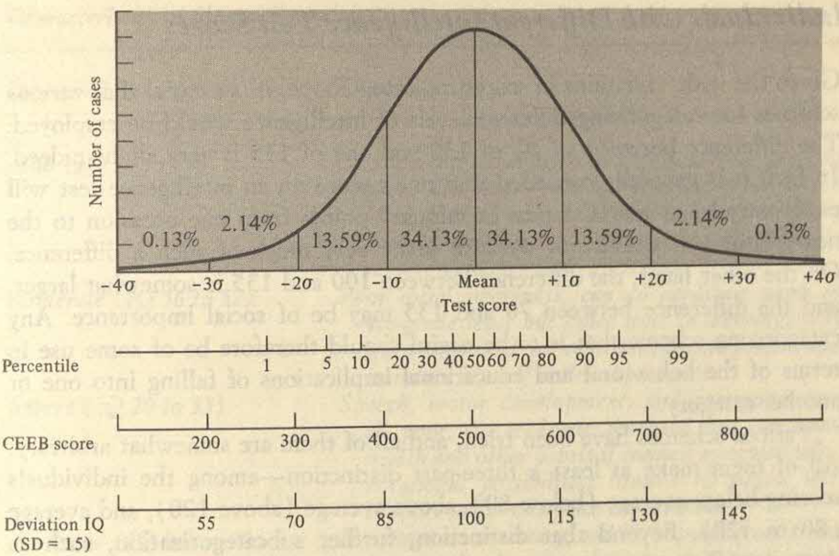

FIGURE 15.5

The normal distribution. In the upper curve the distribution is shown, and the percent of cases falling within each portion measured in terms of the standard deviation units (σ) is indicated. Thus 34.13 percent of the total population will have scores between the mean and +1 standard deviation; 13.59 percent will have scores falling between +1 and +2 standard deviations, etc. Below the curve are shown the percentile ranks corresponding to various scores, the scale for College Entrance Examination Board (CEEB) scores, and the scale for IQ's. Modified from Anastasi, 1958.

about 84 percent of the population. On the other hand, a person who scores 70 on an intelligence test is two standard deviations below the mean [i.e., $100-(15\times2)=70$], and only about 2.5 percent of the population score below that figure.

From the curve shown in Figure 15.5, then, you can get some idea as to what a given IQ score means. Note that very few people will score higher than 145 (three standard deviations above the mean) or below 55 (three standard deviations below). For all normally distributed traits, a good rule of thumb to remember is that the total range of scores is going to be equal to about three standard deviations on either side of the mean, since over 99 percent of the cases fall between those values.

Now you should also understand better the concept of deviation IQ mentioned earlier. A person whose score on an intelligence test is one standard deviation above the mean score for his age peers will have an IQ score of 115, since the distribution of these scores has a mean of 100 and a standard deviation of 15.

To exercise your new understanding: Assume that the population of the United States is 200 million. How many individuals would you expect to find with IQ scores above 165? How many with scores below 70? If a person is in the upper 15 percent of the population, what would his score be? How many individuals would score below average?

Characteristics of Individuals with Different Intelligence Test Scores

Given the wide variations in scores indicated above, it is natural that various schemes for categorizing different levels of intelligence would be employed. The difference between an IQ of 130 and one of 135 is very slight indeed. In fact, it is generally conceded that one's score on an intelligence test will easily vary by as much as plus or minus 5 points from one occasion to the next. Thus you would not want to make very much of such a difference. On the other hand, the difference between 100 and 135 is somewhat larger, and the difference between 70 and 135 may be of social importance. Any categorizing scheme that is to be useful should therefore be of some use in terms of the behavioral and educational implications of falling into one or another category.

Various schemes have been tried, and all of them are somewhat arbitrary. All of them make at least a three-part distinction—among the individuals scoring below average (below 80), above average (above 120), and average (80 to 120). Beyond that distinction, further subcategorization, such as degrees of below-averageness or deciding where above average stops and genius begins, is more variable. Consequently the categories outlined here should not be considered as fixed for all time, and you will probably see them supplanted some day as we come to understand better the differences in intelligence.

Below Average Intelligence

A person is considered to be of below average intelligence if his IQ score is below 80. The range from 70 to 80 is usually called "borderline," and the individuals are classified as "slow learners." Educational and other problems begin to become serious for individuals with IQ's below about 70. This figure is usually considered to be the cutoff point for the classification "mental defective," or, more recently, "mental retardate." If you refer to Figure 15.5, you will see that, theoretically, about 2.5 percent of the population scores below this value (i.e., 5 million in a population of 200 million). In actual fact, the numbers are slightly higher, since it is apparently easier for various genetic, medical, and environmental factors to lower intelligence than to raise it. Thus it is apparent that the sheer numbers make this an important social problem.

Mental retardates are classified as being mildly, moderately, severely, or profoundly retarded, and the characteristics of each are shown in Table 15.3. In recent years special programs have been devised to help these people make the most out of the aptitudes that they do possess. Mildly retarded children are considered to be *educable* to at least a minimal level, which would enable them to function in socially appropriate ways and therefore get along reasonably well in society, and perhaps even support themselves. Moderately retarded individuals are considered to be *trainable,* in that they can learn to perform elementary self-help skills, such as dressing and health functions, and can perform useful work under sheltered supervision. Severely and profoundly retarded individuals are more or less completely dependent on others and may require continual care.

Characteristics of Mental Retardates TABLE 15.3

Degree of Retardation	*Characteristics*
Mild (IQ 53 to 69)	*Can develop social skills and do academic work to about 6th-grade level but is slow to attain the level. Special education required for secondary school; may learn a vocation but will probably require guidance and supervision.*
Moderate (IQ 36 to 52)	*Poor social awareness; can do academic work to 4th-grade level but quite slow in learning; may learn unskilled or semiskilled occupation and maintain himself under supervision.*
Severe (IQ 20 to 35)	*Speech, motor development, and communication all poor; no academic potential but can learn health and other habits if trained systematically; vocational possibilities limited to partial self-support under complete supervision.*
Profound (IQ below 20)	*Nursing care necessary, and little profit from training, academic or otherwise, although some motor and speech development may be possible.*

Source: Modified from Kisker, 1964.

That special forms of education can greatly benefit the brighter of the mentally retarded children is indicated by several long-range studies of mental retardates whose education was received in special classes (Baller, 1936; Charles, 1953). The same individuals were involved in both studies, although the investigators were different. Charles, who tested about 75 percent of the original group, found that the marriage and divorce rates were lower than the national average, and the number of children per marriage was slightly lower. The males tended to be laborers and the females housekeepers, but 83 percent of the group was self-supporting, and a few held managerial positions. When tested with the Wechsler-Bellevue test, 24 of them achieved an average full-scale IQ score of 81, considerably higher than the original scores.

A later follow-up study (Baller, Charles, & Miller, 1967) reported that the mortality rate among the retardates was higher than among two comparison groups of "slow learners" (IQ's 80 to 90) and average children, and that more of them were on public assistance. However, it is significant that the ones who were self-supporting had received their training and had learned their skills early.

The causes of mental retardation are not completely understood. Some forms of retardation seem to be genetically determined, or familial, while others seem to be the result of certain diseases of constitutional abnormalities that affect the functioning of the brain. The majority of the cases, however, are to be expected from the normal distribution of intelligence. This question will be considered more thoroughly in the last section.

Average Intellignece

Individuals scoring between 80 and 120 on intelligence tests fall within the "average" classification. Further subclassification is made as follows: 80 to 90, low average; 90 to 110, average; and 110 to 120, high average. The full group constitutes about 80 percent of the population, and little attention has been focused on them, since they present no special educational problems. Although differences in intelligence test scores within this group are indicative of differing amounts of success in school, it is also true that overall success depends on many different factors, particularly cultural and motivational ones. You can get some idea of the range of variation in intelligence found in many of the occupations engaged in by people in this category by referring to Figure 15.6.

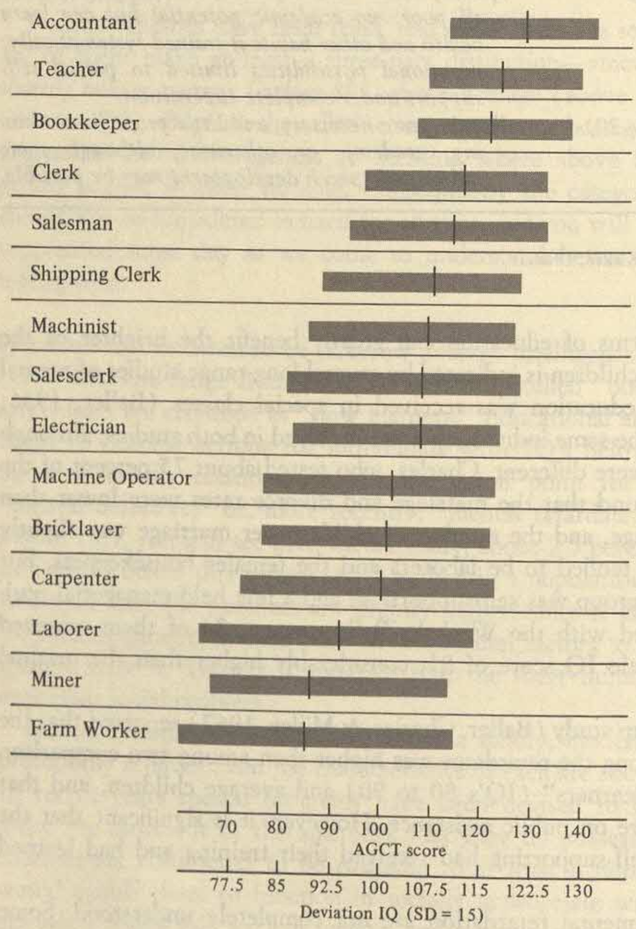

FIGURE 15.6 *Scores on the Army General Classification Test (AGCT) and their corresponding deviation IQ scores of people working in various occupations. The mean score is indicated by the vertical line within each bar, and the range of IQ's is indicated by the width of the bar.*
Modified from Anastasi, 1958.

Superior Intelligence

The terms "superior," "very superior," and "genius" may be used to apply to individuals with IQ scores above 120, although there is no general agreement as to how best to apply which term. This group constitutes the upper 10 percent of the population and should perhaps be considered as "gifted" intellectually. Not everyone would agree with this classification, however, since not everyone with a high IQ is able to make use of his presumed capacity, and many psychologists and educators prefer to reserve the term "gifted" for those who are not only bright but also productive and creative.

What can be expected of individuals with high intelligence? There are several ways of approaching this question. One way is to give some indication of educational and professional expectations of individuals with various IQ's. Thus, according to some estimates, individuals with IQ's up to 125 may expect to finish undergraduate college, while individuals with high IQ's are likely to do well in graduate and professional schools (Kirk, 1972).

Another way to identify expectations of gifted individuals is to study those identified as gifted and determine some of their other characteristics. This can be done by selecting people who have distinguished themselves through their accomplishments, and working back from there—estimating IQ's from biographical material and noting other characteristics. Several such listings of historically prominent people have been made, one of which is shown in Table 15.4.

Some gifted individuals begin to "blossom" at a very early age. For example, John Stuart Mill, whose IQ has been estimated as 190, began to learn to read Greek at age 3 and by age 17 was on the way toward a long and productive career as a philosopher. Another obviously gifted individual

TABLE 15.4

Estimated IQ's of Some Historically Prominent Figures

Francis Galton	*200*
John Stuart Mill	*190*
Johann Wolfgang von Goethe	*185*
Gottfried Wilhelm von Liebnitz	*185*
Samuel Taylor Coleridge	*175*
John Quincy Adams	*165*
Thomas Jefferson	*155*
David Hume	*155*
Alfred Lord Tennyson	*155*
Rene Descartes	*150*
Wolfgang Amadeus Mozart	*150*
William Wordsworth	*150*
Francis Bacon	*145*
Charles Dickens	*145*
Benjamin Franklin	*145*
George Frederick Handel	*145*
John Milton	*145*
Daniel Webster	*145*

Source: Cox, 1926.

who developed precociously was Norbert Wiener, whose mathematical theories provided the basis for many of the modern developments in computer science. He began to read at 3½, entered high school at 9, Harvard at 12, and received his PhD at 18. On the other hand, Albert Einstein was thought to be retarded and had trouble in school. Nevertheless, he taught himself higher mathematics, which he mastered by age 14. Thomas A. Edison was also thought to be dumb by his teachers, but as soon as he left school, he began to blossom intellectually.

In order to investigate the characteristics of gifted individuals in a more thorough way than can be accomplished with only biographical material, Lewis M. Terman undertook in 1920 to identify a large number of intellectually gifted children and to follow as many as possible of these children throughout their academic and professional careers. In this way he would be able to provide direct evidence as to what happened to children with high IQ scores. He began with 1528 children, none of whom had an IQ below 140. The average IQ for the group was about 150. For purposes of comparison he also employed a group of children unselected with respect to IQ, in other words, an average group. For 36 years, until his death in 1956, Terman attempted to keep track of the people in his gifted group, noting what kinds of jobs they had, their relative success, physical well-being, emotional adjustment, etc.

At the outset, he noted that the gifted children were above average in physical and emotional health. They did very well in school with little if any evidence of one-sidedness. Even so they preferred more abstract subjects to such things as penmanship and other kinds of manual training. Socially, they were well-adjusted, although they preferred playing and being friends with only one or at most a few other people. In other words, they were not "group-oriented." As babies they weighed more at birth, and walked and talked earlier than the average child.

The percentage of these people who went to college, graduated with honors, received awards, etc., was much higher than in the population at large; they also tended to go into the high-ranking professions such as law, medicine, academic fields, writing, and into business. Their incomes were considerably above the national average, as was their productivity measured in terms of books, articles, patents, etc.

Not all of the original group of children were successful, success being defined in terms of a person's making productive use of his intellectual talent. The two main features that seemed to differentiate the most from the least successful of the men was overall social adjustment and the drive to achieve. Early cultural environment, including such factors as the number of books in the home, the amount of education of the parents, and the stability of home life were also important. In other words, assuming that the tests which originally identified these gifted people as children were valid, it seems clear that intelligence is not the only factor necessary for success. Motivation, emotional health, and a stimulating early environment are also important.

Regardless of the "failures," the majority of these people as adults

An Unusual Distribution of Talents

The long-range study of gifted children conducted by Terman, described in this chapter, indicated that individuals with superior intelligence tended to be very good at a wide variety of tasks, rather than being one-sided. Perhaps this is true. However, there are other cases, not necessarily involving geniuses, at least in the sense of the term used by Terman, in which an extremely wide distribution of talents is seen. There are case histories, for example, of individuals who could perform amazing feats of arithmetic, including rapidly adding long columns of figures and determining on what day of the week any particular date in history fell, but who were otherwise quite inept intellectually. In other words, their one skill is coupled with intellectual retardation in practically every other sphere.

A case of this sort is described by Anastasi and Levee (1959), who made a careful study of a male adult who developed into an excellent pianist but who was rather retarded intellectually.

Their subject contracted a case of encephalitis when he was in the hospital after birth, and permanent brain damage resulted. His retardation was obvious; he did not speak until he was 5 years old, although he hummed tunes that he had heard even before beginning to talk. His parents were quite well-to-do so that he had the advantage of a wide variety of special educational experiences, including musical training. He learned to read but would not voluntarily read anything. When he did read, he apparently lost much of the abstract meaning of the material. On the other hand, his phenomenal memory permitted him to recite verbatim passages of more than two pages in length after only one reading. Events that occurred more than a month or so in the past were also recalled quite accurately and completely. However, he was less good at remembering things that happened in the immediate past.

His IQ as measured by the Stanford-Binet was 67, and he performed quite poorly on tasks except those that primarily involved memory and concrete information. His Wechsler IQ was 73 (Verbal = 92, Performance = 52), and his performance on this test was quite variable.

His main interest was music, and he practiced compulsively and at great length, usually 6 to 9 hours per day. He was recognized by professional musicians as being very talented.

In general, then, this person was quite good at memorizing and at music but was poor at everything else, particularly anything involving the appreciation of abstract ideas. There are no good explanations of this phenomenon. It seems obvious that the characteristics of this person are somehow related to postnatal brain damage, although little else can be said. Perhaps his physiological disorder prevented him from being distracted from his music by other things that might entice an ordinary person away from the concentration required for mastery and, given the educational opportunities provided by his parents, he was thus able to progress further.

showed above-average emotional and social adjustment. The incidence of personality disturbance was somewhat less than in the population at large, as was the incidence of divorce, delinquency, alcoholism, etc.

The argument which Terman advances on the basis of his findings is that a general intelligence test, administered at an early age, can do a good job of predicting the success of adults. This fact is not surprising, considering the role that school education plays in our society. The cultural and motivational factors that seemed also to be related to success in Terman's group, no doubt exerted a major influence in how far a given child went in school. To put the matter differently, the predictability of success on the basis of intelligence test scores may be limited to particular cultural and environmental circumstances.

The fact that formal education is so important for success in our society may be the main variable operating here. We, of course, cannot change society in order to conduct the necessary controlled experiment to see how general the predictive ability of intelligence test scores actually is, i.e., whether the tests would predict equally well in a predominantly agricultural society, or one in which educational practices were quite different. The main point is that intelligence test scores are interpretable only within a given culture.

Determinants of Intelligence Test Performance

Given the wide range in test scores obtained in the population at large, and given some of the social and educational implications of these differences, the question is now posed: What are the bases for these differences? Before describing some of the attempts to answer the question, it is important that you realize that, at the moment, *we do not know the answer.* Investigations have pointed to the importance of heredity, diet, general physical condition, and cultural enrichment or deprivation, certainly a very heterogeneous assemblage of causative factors, none of which is very well understood either acting alone or in interaction with other factors. The issue becomes a political "hot potato" as, for instance, when one considers possible racial differences in intelligence test scores, or when one questions whether or not the government should build early learning centers in order to counteract some of the detrimental effects of cultural deprivation associated with poverty.

In such a climate it is difficult to approach the question in the dispassionate manner that is usually advocated for the scientific enterprise. Perhaps this is as it should be, for the public at large contains elements which are quick to grasp onto even the most tentative scientific conclusions which sound as though they might support a particular political position. For example, as soon as Arthur Jensen's (1969) article appeared in which he argued that blacks were intellectually disadvantaged relative to whites, a disadvantage which he attributed to heredity, his arguments, or misrepresentations of them, began to appear in the arguments made by white southern

lawyers in public school desegregation cases (Brazziel, 1969). While Jensen is not as tentative about his conclusions as most psychologists who read them, the impact of his statements, taken as "scientific fact" by those obviously motivated to do so, involved a clear misunderstanding of the relevant issues and the factual and theoretical basis on which Jensen's statements were made.

The conflict, then, is a very real one, between the demands of scientific detachment on the one hand and social awareness on the other. If the study of intelligence proves to be a jumble of conflicting claims and counterclaims for the next 10 or 20 years, it is partly because of this conflict.

The discussion that follows probably reflects this conflict also. However, the attempt will be made to communicate some of the findings concerning the major factors affecting intelligence test scores.

Hereditary Influences on Intelligence

One of the first to study systematically the inheritance of intelligence was Sir Francis Galton (1869), some of whose ideas were mentioned earlier in this chapter. Galton, himself a genius (See Table 15.4), was influenced by the ideas of his half-cousin, Charles Darwin, whose ideas about evolution have been so influential. Galton conducted a careful biographical study of eminent people in British society and came to the conclusion that eminence tended to run in families. He argued that the basis for this finding was heredity, and subsequently devoted much of his efforts to founding the *eugenics* movement, the aim of which was to improve the human species through the intelligent selection of mates.

Galton's work was by no means adequate by modern standards, since by now we know that in order to study the influence of heredity on some characteristic, the effects of environment must be controlled while genetic makeup is varied, or vice versa. Although it is possible for selective breeding programs to be instituted for studying inheritance in animals, such is not considered ethical in the case of humans. Therefore, other techniques, more indirect, must be employed.

More recent studies have examined the extent of correlation in intelligence test scores between individuals of varying degrees of genetic similarity ranging from monozygotic, or identical twins, to unrelated individuals reared in the same, or in different, environments. (Some identical and fraternal twins, as well as brothers and sisters in general, are reared in separate homes.) One summary of such studies is depicted in Figure 15.7, which shows that the closer the degree of relationship between pairs of individuals, the higher the correlation in intelligence test scores. Also, those reared in the same environment tend to be closer together in IQ than those reared in separate environments.

These studies, thoroughly reviewed by Jensen (1969), indicate that there is probably a substantial genetic contribution to whatever it takes to do well on an intelligence test. However, psychologists are not at all in agreement as to how to interpret these findings. One problem in interpretation is that the more similar the environments overall, the greater will be the contribution

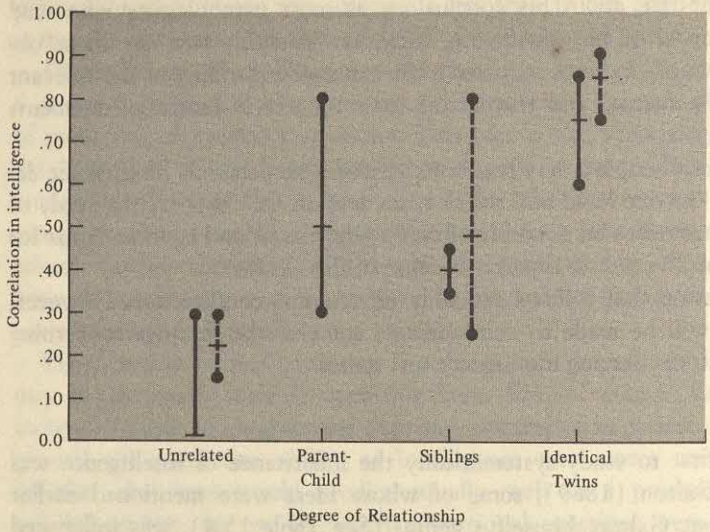

FIGURE 15.7 *Similarity in intelligence and degree of genetic relationship. The ordinate is the correlation between pairs of individuals, and the abscissa is the degree of genetic relationship. The dashed lines are for individuals reared together, while the solid lines are for individuals reared apart. The extremes of each line indicate the range of correlations found in different studies, while the dash across each line indicates the median correlation obtained.*
Adapted from Erlenmeyer-Kemling & Jarvik, 1963.

of whatever genetic factors there are. (Thus, if everyone had the same environment the only source of individual differences would be genetic.) So far, the contribution of genetic factors over the range of environments characteristic of a given culture has yet to be determined.

In spite of the uncertainty of the extent of the genetic component in intelligence, in the population at large, there are two clear-cut instances of genetic disorders that may lead to mental retardation. Both of them involve alteration in brain functioning and the consequent lowering of intelligence. One of them is phenylketonuria, and the other is Downs syndrome, or mongolism.

PHENYLKETONURIA

In phenylketonuria (see also p. 58) there is an alteration in the metabolism of phenylalanine, one of the essential amino acids. Because of the absence of a single enzyme it is not metabolized (broken down) properly, and consequently accumulates in the bloodstream. In large quantities it is toxic to the nervous system, and, if untreated, mental deterioration will result. Its effects can be escaped by providing a diet containing no phenylalanine.

DOWN'S SYNDROME

Down's syndrome, or mongolism, was at one time thought to be inherited. Now it is thought to be caused by an abnormality in the chromosomes (either an extra chromosome or a broken one) that is genetic (i.e., the char-

acteristics are a result of the operation of genes) but which is not inherited. Defective germ cells are apparently responsible, but the defect presumably occurs after the birth of the parent who supplies them. One of the symptoms of mongolism is mental retardation, with IQ scores usually ranging from 30 to 50.

Environmental Contributions to Intelligence

It is clear that performance on an intelligence test is very much determined by whether or not the person being tested has learned certain skills which are prerequisite to taking the test at all. Following verbal instructions, for instance, is quite important, as is the motivation to perform well. Much of what the testee brings into the testing situation is, then, learned, and the test score would not be expected to be a valid predictor of his success unless he had learned the required behaviors. In other words, a test score may have meaning within a particular culture, where such learning may be assumed to have occurred, but little generality outside of that culture.

In recent years various attempts have been made to produce a "culture-fair" intelligence test, i.e., one that is not culture-bound. These attempts have been singularly unsuccessful, mainly because of the strong verbal component in most tests. While nonverbal (i.e., perceptual-motor tests) might presumably be less culturally biased, even here the role of culture is apparent. For instance, Deregowski (1972) reports that a basic perceptual skill, such as responding to depth as represented in pictures, is mostly learned, and individuals whose cultures do not stress this kind of learning do not perceive pictorial depth in the same way most of us do. If intelligence is to be conceived of as some innate biologically determined capacity, then thus far no one has found a way to measure it independently of particular forms of past learning, and in anything other than a particular social and cultural context.

Over and above general considerations of the role that particular learned behaviors play in test performance, there is a great deal of research which shows that nongenetic and nonhereditary factors have significant effects on an individual's development. This research will be discussed briefly under two headings: nutrition, and environmental enrichment and deprivation.

NUTRITION AND INTELLIGENCE

In order to develop properly, the brain has certain minimum nutritional requirements, primarily in the form of proteins, vitamins, and minerals. Evidence is accumulating (e.g., read Kaplan, 1972, for a recent review of the literature on this topic, and Warren, 1973, for a critique of this research) that mothers who are inadequately nourished during pregnancy tend to have babies whose brains weigh less and are less well developed than is the case with adequate nutrition. They are also more likely to have babies with congenital malformations of the nervous system, many of which lead to mental deficiency. Autopsies have been performed on babies who died of malnutrition, and, when the malnutrition occurred during the first six months of life, when the cells of the brain were still dividing, the result was a considerable reduction in the number of brain cells. These findings have been confirmed

in more systematic investigations using animals as subjects, although there is still some question about the permanence of the effect, given an adequate diet later.

Nutritional diseases, such as kwashiorkor, which is primarily due to protein deficiency, are often characterized by mental apathy which is sometimes reversible when an adequate diet is administered.

Other studies have indicated that there is a positive relationship between birth weight and intelligence. When identical twins are studied, for instance, one of the twins is often heavier than the other, primarily because of inequalities in the distribution of the maternal blood supply. In one study (Willerman & Churchill, 1967) 27 such sets of twins were tested at ages ranging from 5 to 15. There was a significant difference in intelligence test performance favoring the heavier twin.

Nutrition may also operate indirectly across generations. In a long-range study made at the Harvard School of Public Health, Kirkwood (1955) noted that mothers who were well-nourished when they themselves were children produced babies who were generally healthier. Other findings are discussed by Kaplan (1972) which reinforce this point and suggest that the effects may operate through influences on the size of the pelvic region of the prospective mother. Small pelvises are more likely to injure the unborn babies.

The understanding of nutritional effects on intelligence is only beginning, with conflicting interpretations of the data that have been found. However, we may expect to find the area considerably better developed in the future. It is clearly of major social importance, though, since adequate nutrition seems to be largely correlated with social class. A main effect of poverty is to reduce the intake of protein calories, at least in the absence of knowledge about how to obtain an adequate amount of low-cost protein. This fact, as already indicated, may be highly relevant for brain development. Since much of the current controversy over intelligence centers about the causes and importance of cultural, ethnic, and racial differences in intelligence test performance, an understanding of the role of nutrition is quite obviously relevant.

ENVIRONMENTAL ENRICHMENT AND DEPRIVATION

Some environments are stimulating, while others are not. Some environments are so plain as to border on sensory or perceptual deprivation (see Chapter 6), while others are full of new things to see, feel, touch, question, and understand. In some environments so many things are happening that it is impossible to attend to any one experience long enough to respond adequately to it. In recent years the question has been raised as to what effect variations in the level of stimulation in the environment might have on the developing intellectual functioning of a child.

There is evidence from several quarters that extreme sensory deprivation has deleterious effects on the intellectual functioning of human children, although the effects may be reversible if adequate stimulation is provided later (however, see p. 460). Skeels and Dye (1939), for instance, report that children reared in an understaffed orphanage in which little interpersonal

The Transfer Index: Candidate for a Culture- and Species-fare Intelligence Test

One of the pressing concerns among psychologists and others interested in intelligence and its functions has been to develop a test of general intelligence that is relatively unaffected by variations in culturally conditioned habits, modes of thinking, usage of language, etc. It seems rather clear that all of the present intelligence tests require a heavy dose of culturally specific verbal skills in order for a high score to be achieved. Questions that have one meaning in one culture may be misinterpreted by someone from another culture, although the two individuals may be equivalent in "general intelligence." Needless to say, the problem is rather immense, and thus far efforts to devise such a test that is "culture-fair" have been unsuccessful.

Recently, however, several researchers working from the tradition of comparative psychology have worked with a test of cognitive skills that appears to be applicable to a wide range of individuals—not only humans, but also other primates such as chimpanzees. Duane M. Rumbaugh, at Georgia State University and the Yerkes Regional Primate Center (1970), has devised a "transfer index" measure that essentially measures the ability of a subject to apply what it has learned in a flexible, adaptive manner, irrespective of overall learning ability.

The procedure is to train a subject to discriminate between two objects, one of which is positive and the other negative. Correct choices result in rewards. After achieving a criterion of about 85 percent correct, the reward values are reversed for the next 10 trials, i.e., the positive object is made negative, and vice versa. Next, a new object discrimination problem is learned to criterion, the values reversed for 10 trials, a third problem learned to criterion, etc., until 40 or so different discrimination problems have been run. The transfer index (I) *is obtained per block of 10 problems by the following formula:*

$$I = \frac{R}{C}$$

where R *is the percentage of correct choices on trials 2 to 10 of the reversal phase, and* C *is the percentage of correct responses achieved on the prereversal, criterional trials. Thus the number* I *will be high if the animal does well on the reversal trials relative to the prereversal trials, and will be low if he does poorly on the reversal trials. Note that the* I *measure will be low, even though the animal may perform quite well on the original learning trials, if it does not learn the reversal well.*

This measure has been used in several studies with children and chimpanzees. In one study Smith (1973) examined the relationship between

performance on the transfer index test and measured intelligence in 4-year-old children. The correlation between IQ and the transfer index was .72, and that between mental age and the index was .76, both of which are quite high.

In another study (Davenport, Rogers, & Rumbaugh, 1973) chimpanzees who were born and raised for the first year in the wild were compared with those who were reared for their first 2 years in the laboratory under restricted conditions, including social isolation and visual deprivation. After the first 2 years they were raised with other chimpanzees under standard laboratory conditions. All of the chimps were from 12 to 14 years old when tested so that there had been at least 10 years in which to recover from the effects of the deprivation.

The deprived chimps were inferior to the wild-reared subjects in terms of the transfer index. Interestingly enough, though, the two groups did not differ in terms of the ease with which the original discrimination problems were learned. Thus, while the groups were similar in many respects, they differed in the flexibility with which they could approach the discrimination problems. These results seem significant in view of the relatively long time intervening between initial deprivation and testing (10 years), and indicate that there might be permanent deficits associated with reduction in stimulation at an early age.

It is premature to offer great promises for this method as a bridge across cultural gaps. However, the results thus far are encouraging and seem to indicate that comparisons among cognitive skills for individuals differing widely in culturally conditioned skills are possible.

stimulation, as well as little external stimulation in general, was available, were deficient in IQ measurements. However, those children who were taken from the home before 30 months of age and placed under the care of retarded female inmates of a state institution and then later adopted, developed normally. Those left in the orphanage remained quite deficient (Skeels, 1966). Although this kind of deprivation is undoubtedly quite severe, the findings do indicate that normal development requires a certain minimal level of stimulation. At this point we do not know what that minimal level is.

An interesting and potentially fruitful approach to understanding the way in which environmental differences can produce rather large differences in IQ that would, on the face of it, appear to be hereditary, is reported by Light and Smith (1969). The mathematics of their approach is too involved to present here, but the qualitative aspects of their findings are of interest. Rather than investigate the role of hereditary and environmental factors in real people, they constructed a mathematical model that stimulated several

feasible relationships between heredity and environment. Then they had a computer make calculations of IQ's for various groups of individuals differing in environmental advantages. In one case they were able to show that the difference in IQ between blacks and whites, which has been found to average about 15 IQ points, can be completely accounted for by variations in environment such as those that might be represented by different conditions of simulation during infancy, different educational opportunities, etc. This finding occurred even though the very strong contribution of heredity to intelligence was recognized by the model. The point seems to be that, even though there is a strong hereditary component in intelligence, small environmental differences can produce rather large differences between groups of individuals measured on any one test.

Extra stimulation may also enhance development, at least in certain specific instances. Greenberg, Uzgiris, and Hunt (1968) showed that the onset of the blink response in infants could be accelerated by placing an attractive pattern over the crib. In another study, White and Held (1966) showed that eye-hand coordination could be accelerated by an enrichment program designed to provide more experience with the visual consequences of reaching. Hunt (1969) uses these examples to argue that the nervous system is quite plastic (i.e., subject to manipulation through experience) at an early age and that a well-designed program of enrichment might speed up development quite a bit.

There is additional evidence from animal studies that environmental stimulation has relatively permanent effects on the brain. Krech, Rosenzweig, and Bennett (1966) have shown that rats provided with relatively complex environments (containing objects to manipulate and varieties of spaces to run about in) developed thicker cerebral cortexes than did control rats reared in the ordinary laboratory environment. Biochemical changes also occurred in the brains, which suggested that the brains of the stimulated animals were more active than those of the control animals. The stimulated animals were also better able to learn complex mazes, indicating that there were psychological consequences of the increase in brain tissue and activity.

What are the implications of the above facts involving diet, deprivation, and enrichment, for an understanding of differences in intelligence test scores? Actually, at this point, one can only guess. The findings discussed here rather clearly point to the importance of these factors for intellectual development, and it would be quite surprising if they were not borne out in future studies. The problem in interpretation comes in relating the extremes of dietary insufficiency and environmental deprivation in the studies cited to levels typically encountered in society. In other words, are real-life situations sufficiently debilitating or enhancing to effect measureable changes in intellectual functioning? If so, what are the minimal levels required for normal development, and how much enrichment can be beneficially applied? Answers to these questions must await further research.

Summary

Present-day conceptions of intelligence come from two sources. One of these sources is philosophy, particularly those branches emphasizing the study of the intellect and thinking. The other source is more recent and began with a practical concern for predicting individual differences in ability to do school work. The former approach is termed structural because it emphasizes the structure of the intellect. Piaget is a major contributor to this approach, viewing intelligence as a biologically adaptive process bridging the gap between instinctual response tendencies, on the one hand, and excessive sensitivity to environmental variations, on the other. The latter, psychometric approach focuses upon measuring "intelligence," which is viewed as a collection of traits enabling one to do well in school, together with a general (*g*) trait more or less supplementing the effects of the collection of traits.

Intelligence tests are designed primarily to measure scholastic aptitude, i.e., the ability to do school work. The original intelligence test designed by Binet had this aim, and later versions of it, including the Stanford-Binet, have received wide use for this purpose. Binet-type tests give only a single score, the IQ. Tests both for adults and for children were designed by Wechsler to give a more differentiated picture of intellectual aptitude, providing scores on 11 different scales as well as a verbal and a performance (perceptual-motor) IQ.

In the past IQ was measured as a ratio between one's mental age and his chronological age. However, the deviation IQ is used more often now. This IQ expresses a person's test performance in terms of how he stands relative to his age peers.

Other tests include group tests, which can be administered to large groups of people, and tests to measure more specific aptitudes for learning particular jobs.

The IQ scores are distributed according to the normal, bell-shaped curve. The mean of the distribution is 100, and the standard deviation is 15.

Individuals obtaining IQ scores below 80 are classed as mentally retarded, subcategories being borderline, mild, moderate, severe, and profound retardation. People in the upper three categories may profit from special education and can become at least partly self-supporting. People in the severe and profound categories may require institutionalization.

Within the average range (80 to 120) there is great variability in respect to expectations of success. While various occupations require different levels of intellectual aptitude, within each occupation the range of IQs is quite broad.

Superior and gifted children (over 120) tend to be more successful, physically healthy, and emotionally well-adjusted than average or below-average children, although one's ability to profit from a high intelligence depends on environmental stimulation and motivation as well.

Individual differences in intelligence scores may be attributed to num-

ber of different factors. Heredity plays a role, although its importance is not completely understood. Environmental factors found to be of importance include diet (both of the mother before birth and of the child afterward), and the presence or absence of environmental stimulation. Children raised in exceedingly deprived environments do not develop normally. The manner in which hereditary and environmental factors interact to produce a given level of intelligence is not at all understood.

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Personality

16

The term *personality* comes from the Greek word *persona*, meaning *mask*, such as was worn by actors in dramatic productions. In one sense, a mask is the face that one presents to the world, and one's personality is the picture of himself that he presents to the world. Different psychologists have advanced different definitions of personality, focusing upon different factors which they think affect how one presents himself, but all definitions imply that the person's personality is important because it affects the way he is evaluated and responded to by other people. Beyond that point, different *theories of personality* focus upon different aspects of the person.

The *trait approach* focuses upon an individual's characteristics. One person might be considered as dominant, friendly, and extroverted; while another might be submissive, cold, and introverted. The person is thus described with reference to a set of adjectives that refer to his overt behavior. The adjectives may also be thought to reflect some underlying basic dispositions that manifest themselves in various ways and are the *sources* (causes) of a variety of behaviors. Thus some traits reflect *surface behaviors*, while others refer to basic *source dispositions*.

The *psychodynamic approach* emphasizes a person's motives and, in particular, the motivational conflicts he might have. The operation of motives such as sex, aggression, fear, and anxiety play a major role in most psychodynamic accounts of personality.

The *social learning approach* focuses upon an individual's behaviors and attempts to understand them as learned responses to particular social situations. Learning to behave in particular ways through imitation of models ("modeling") and through socially established reinforcement contingencies play important roles in this approach to understanding personality.

The *cognitive* and *phenomenological approaches* place great importance on understanding a personality in terms of the way one thinks (cognitive) about himself in relation to other people, or the way one experiences or perceives (phenomenological) himself. They differ from the other approaches

in their primary concern with understanding the person as he is in the present, or the "here-and-now," as opposed to focusing upon past learning as the key to the present.

These four approaches or theories constitute the major ways that psychologists have come to view personality. The differences among them seem to represent some fairly basic differences as to how best to understand behavior. Some of these differences you have already encountered in connection with the questions about whether or not psychology can meaningfully study conscious experience, or whether it should limit itself to the study of behavior. Also, the question of how to deal with the concept of motive, which was considered in Chapter 12, reappears here in evaluations of the psychodynamic approach to personality.

Regardless of one's particular approach, however, any point of view must ultimately deal with at least three major problems. The first of these is that of *assessment*. How does one find out about a personality? How does one *measure* motives, traits, or whatever else one thinks is important about personalities? Different means have been developed for assessment which seem to be related to the theoretical differences just outlined. These differences also have a bearing upon the type of research conducted on personality. The second problem is that of *development*. How does an adult get to be the way he is? Does development proceed in stages that are for the most part the same from one person to another, or is it more or less haphazard, depending on the opportunities for learning particular behaviors? Is development largely set down in the genetic and constitutional makeup of the individual, or is it subject to significant variation by changing the environment? Both the psychodynamic and the behavioristic approaches have very distinct ways of regarding personality development. The third problem is that of personality *deviance*, which we shall consider in the next chapter. The approaches, of course, differ in terms of the importance they attribute to these three problems. Development, for instance, is of less concern to the phenomenological theorists than to the psychodynamic or social learning theorists.

In this chapter we shall first consider the different theories of personality outlined at the beginning of the chapter. In the process of description, it is hoped that you will come to appreciate not only the major ideas characteristic of each, but also the types of observations upon which each theory is based and the ways in which each predicts or fails to predict behavior. Their implications for assessment and development will be considered. You will probably find that some theoretical approaches appeal to you more than others. This is quite natural, since each of us has his own ideas as to the nature of man, and these theories certainly bear upon this issue. It is important to be aware, however, that the success, or validity of any approach must ultimately depend upon how well it can predict and explain behavior and experience, and not necessarily upon its popular appeal. Also, you should be aware that the different theories focus upon different aspects of human behavior and experience, and thus are not directly comparable.

Theories of Personality

Trait Theories

A trait may be defined as a relatively permanent and distinguishing feature that enables you to differentiate one person from another. It may also be interpreted as a *disposition* to behave in a particular way. When people are grouped on the basis of some pattern of similarities, then the term *type* is used. Both terms are important in the description of personality characteristics. This approach to personality is closely allied to the psychometric approach to intelligence discussed in the previous chapter. Indeed, intelligence itself may be considered as a personality trait.

TEMPERAMENTS

Describing people according to types has a long history. Hippocrates, for instance (ca. 400 B.C.) divided people into four types on the basis of their temperaments: melancholic (depressed or sad), choleric (irritable, quick to anger), sanguine (trustful and optimistic) and phlegmatic (slow, calm, listless). He related the four temperaments to excesses of the four body humors (fluids), which were, respectively, black bile, yellow bile, blood, and phlegm. Some of these terms are still used to describe people, particularly in literature.

BODY TYPES

Through the ages body characteristics have also been used as the basis for descriptions of personalities. Shakespeare, in *Julius Caesar* had Caesar complain:

> Let me have men about me that are fat,
> Sleek-headed men, and such as sleep a'nights.
> Yond Cassius has a lean and hungry look.
> He thinks too much. Such men are dangerous.

These four lines describe two of the body and personality types formalized by Kretschmer, a German psychiatrist, and more recently by Sheldon and Stevens (1942), two American investigators. The system is summarized in Figure 16.1. From the figure you will see that Caesar preferred to have people with endomorphic body build and viscerotonic temperament. He distrusted ectomorphs with cerebrotonic temperament.

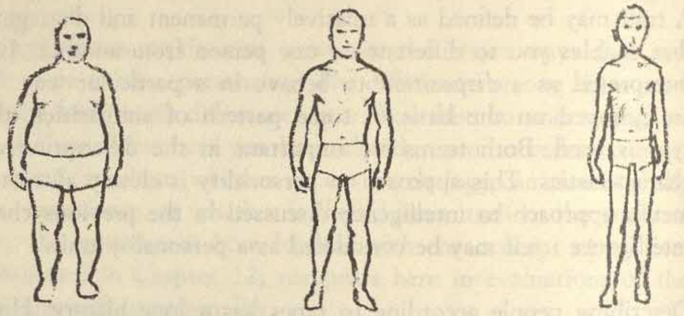
Many psychologists object to these typologies because they are too simple and imply that a person's characteristics may be described by reference to only one or two concepts. Also, there is an objection to the either-or nature of the concepts. A person is either cerebrotonic or viscerotonic, implying that the name describes much of his behavior. Sheldon's approach tries to avoid this problem by providing for various degrees and combinations of the three basic types, and research has shown that there is some relationship between body build and personality. Psychologists, however, have not uniformly accepted the relevance of these findings (Suinn, 1970).

TRAITS

Suppose that you take the other extreme and develop a very complex system for description. You might start out by going to a dictionary and searching

	Endomorphy	Mesomorphy	Ectomorphy

Body build



	Viscerotonia	Somatotonia	Cerebrotonia
Temperament	Friendly Comfort-loving Dependent Slow reactions Sleeps well Relaxed bearing	Restless Aggressive Competitive Noisy Adventurous Likes activity	Quick reaction A "loner" Poor sleeper Rigid bearing Socially inhibited

FIGURE 16.1 *Sheldon's somatotypes. Extremes of the three types, endomorphy, mesomorphy, and ectomorphy, are shown, together with the personality characteristics associated with each.*
From Sheldon and Stevens, 1942.

for words that describe how persons behave or feel, and then deciding for each adjective you find how applicable it is to the person. You would come up with a very complete description, which would probably be able to differentiate any one person from everyone else. Such a system would clearly not be very efficient because there are approximatly 18,000 such adjectives in an unabridged dictionary. However, by eliminating synonyms and rare words, and keeping only the adjectives that describe traits (e.g., vivacious, likeable, shy, etc.), we are left with a more manageable total of 170 words.

One investigator, R. B. Cattell (1946), reduced the list further by grouping them into 35 broad categories. Then, using a statistical procedure known as *factor analysis* (which groups tests that seem to be measuring the same traits), the list was reduced to 12 traits. Later research has yielded other numbers of traits, and recent work by Cattell mentions 16 traits (Table 16.1). These 16 traits are considered by Cattell to be *source traits*. Source traits are thought to refer to personality structures that are the causative factors underlying the differences between people. *Surface traits*, on the other hand, are simply groups of behaviors that go together. They are to be explained in terms of the operation of source traits.

Other psychologists feel that fewer traits will do just as well. The British psychologist H. J. Eysenck, for example, has concluded from his own research that only three major traits are necessary. One of these traits is *emotional stability versus neuroticism*. A person high in neuroticism will be anxious, tend to have narrow interests and excessive dependence on others,

Cattell's 16 personality factors or traits TABLE 16.1

A.	Reserved, *detached, critical, aloof*	versus	Outgoing, *warmhearted, easygoing, participating*
B.	Less intelligent, *concrete-thinking*	versus	More intelligent, *abstract-thinking, bright*
C.	Affected by feelings, *emotionally less stable, easily upset*	versus	Emotionally stable, *faces reality, calm, mature*
E.	Humble, *mild, accommodating, conforming*	versus	Assertive, *aggressive, stubborn, competitive*
F.	Sober, *prudent, serious, taciturn*	versus	Happy-go-lucky, *impulsively lively, gay, enthusiastic*
G.	Expedient, *disregards rules, feels few obligations*	versus	Conscientious, *persevering, staid, moralistic*
H.	Shy, *restrained, timid, threat-sensitive*	versus	Venturesome, *socially bold, uninhibited, spontaneous*
I.	Tough-minded, *self-reliant, realistic, no-nonsense*	versus	Tender-minded, *clinging, over-protected, sensitive*
L.	Trusting, *adaptable, free of jealousy, easy to get along with*	versus	Suspicious, *self-opinionated, hard to fool*
M.	Practical, *careful, conventional, regulated by external realities, proper*	versus	Imaginative, *wrapped up in inner urgencies, careless of practical matters, bohemian*
N.	Forthright, *natural, artless, unpretentious*	versus	Shrewd, *calculating, worldly, penetrating*
O.	Self-assured, *confident serene*	versus	Apprehensive, *self-reproaching, worrying, troubled*
Q_1	Conservative, *respecting established ideas, tolerant of traditional difficulties*	versus	Experimenting, *liberal, analytical, free-thinking*
Q_2	Group-dependent, *a "joiner" and sound follower*	versus	Self-sufficient, *prefers own decisions, resourceful*
Q_3	Undisciplined self-conflict, *follows own urges, careless of protocol*	versus	Controlled, *socially precise, following self-image*
Q_4	Relaxed, *tranquil, unfrustrated*	versus	Tense, *frustrated, driven, overwrought*

Source: From Cattell et al., 1970.

and is easily distracted and frustrated. At the other end, an emotionally stable person has wide interests, is cheerful, independent, and can carry out his activities without being overly distracted by external stimuli.

Extroversion versus introversion is the second trait. An extrovert attends more to external stimuli, including both objects and people, than to his own thoughts and feelings. He will be more distractible than the introvert who, in turn, will show greater persistence in tasks than extroverts. Extroverts are more spontaneous and exhibit more mood changes than introverts.

The third trait is *realism versus psychoticism*. The realistic person can concentrate on tasks well, has good memory and dexterity, and can communicate well. A person high in psychoticism, on the other hand, is unrealistic, cannot communicate very well, has a poor memory, and may distort reality in his own way.

These three dimensions, it should be emphasized, are not names for personality types. There is no such thing as, for example, a typical extrovert. Most people are somewhere in between the extremes, and would be difficult to classify as either "type." The same is true for the other dimensions, and Figure 16.2 shows some of the possibilities.

Other psychologists focus on a few, isolated, personality traits. That is, rather than attempt to describe personality completely, they have studied one

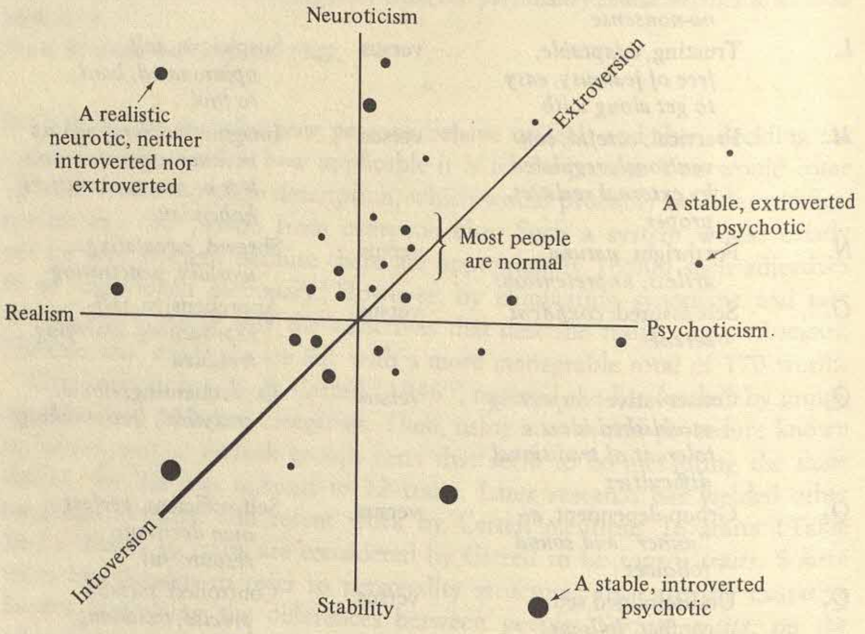


FIGURE 16.2 *Eysenck's three personality dimensions, introversion-extroversion, realism-psychoticism, and stability-neuroticism, are shown graphically. You should read the graph as a three-dimensional representation. Large dots refer to scores close to you, i.e., on the introversion side, while small dots indicate scores far from you, on the extroversion side. Some of the possible combinations of scores are indicated, with most normal people falling near the intersection of the three axes, i.e., being extreme on none of the dimensions.*

or more traits that seemed to be important. Thus, for example, there has been much research on the trait *dogmatism*, which is the tendency to be closed-minded about various matters of opinion. Rokeach (1960) has devised a test to measure this trait. *Authoritarianism* is another such trait. An authoritarian tends to reject people different from himself, especially members of minority groups, and to be highly moralistic. This trait has been investigated in a number of studies, some of which are described in Chapter 19.

A third example is *Machiavellianism*, or the tendency for one person to use other people for his own goals and purposes. This trait was named after Niccolo Machiavelli (1469–1527), who in his book *The Prince* advocated such behavior for politicians. The Mach scale (Christie & Geis, 1970) was designed to measure this trait; some research using it is described in Chapter 19.

WHAT IS A TRAIT?

What is the meaning of a trait? One interpretation is that a trait simply describes behavior and does not really refer to any underlying attribute of the person. In this sense, it provides no help in explaining behavior, being only a more sophisticated descriptive device. If this were all that is implied, we would be led to make such circular statements as a person persists in his work because of his trait of persistence. Another interpretation, for example, that of Cattell, is that at least some traits reflect underlying personality structures, and as such have explanatory value.

It should be clear that no source traits are observed directly. In Cattell's research they are inferred from various kinds of data, including life records, ratings of everyday types of behavior, self-ratings by the subjects, and the results of objective tests. The extent to which the traits resulting from the factor analysis of such data are actually descriptive of a person's behavior in "real life" depends upon the extent to which the basic data are representative of real life. It would seem that a broadly based approach such as that taken by Cattell would be able to yield reasonably general traits. However, one of the goals of personality research is to determine as completely as possible the limits of generality of such formulations, and much remains to be done.

Psychodynamic Theories

While the trait approach focuses upon underlying dispositions and their effect upon behavior, the psychodynamic approach stresses the importance of an individual's impulses and drives, or motives. In contrast with both the trait and the behavioristic views, overt behavior is not considered to be very important, since a given behavior may be the expression of any of a number of motives, and a given motive may be expressed in any of a number of different ways. The motives, which are the important elements, are mostly unconscious, and therefore can be uncovered only in very subtle and indirect ways.

FREUD'S THEORY

Virtually all psychodynamic approaches to personality owe their main ideas to the work of the Viennese physician, Sigmund Freud (1856–1939). Freud

thought that behavior was the result of the operation of basic drives, mostly unconscious, centering around the biological needs for preservation of the individual and the species, particularly sex and aggression. He felt that even the most sophisticated, unselfish, and altruistic behaviors of adults resulted from the operation of these basic biological motives, and his theory attempted to show how the adult's professed motives and his behavior could be explained by understanding these unconscious processes.

The primary driving force for behavior and other psychological processes, such as imagination and thinking, is *psychic energy*. The psychic energy involved in the preservation of the individual and the species is called *libido*. The term is often used to refer specifically to sexual motivation, but Freud had a broader concept in mind. This energy, which is just physiological energy that happens to be devoted to psychological processes, is collected into *instincts*, or motives. When a motive is aroused, a state of *tension* results which can only be relieved when a goal appropriate for the motive (or some substitute) is found. Thus, when one is hungry, tension increases, which can be reduced by food; or, when a piece of grit gets into the eye, the tension can be reduced by blinking and removing the grit.

As a result of the interaction of the biological motives with the real world, including other people, the personality differentiates into three parts. The first of these is the *id*, which is present at birth and is the ultimate source of *all* psychic energy, even that used by the other parts. The id remains unconscious throughout life so that the individual is never aware of its operation. When tension is aroused, the id seeks immediate tension reduction, which is pleasurable. Thus it is said to operate according to the *pleasure principle*, which includes forming an image of the goal that would reduce the tension. Unfortunately, the id has no way of dealing with factual situations, and images do not work very well in satisfying, say, hunger. Consequently, the *ego* develops as the second major part of the personality.

The function of the ego is to bridge the gap between the id and the real world, and it eventually comes to be the "executive" of the personality. Its principle of operation is called the *reality principle*, which involves realistic thinking and the postponement of gratification until an appropriate goal is found. All intellectual capacities, such as thinking and problem solving, are exercised by the ego.

As the ego develops, the child becomes aware of the consequences of his actions. Certain behaviors are rewarded; others are punished. As you will see when we take up Freud's theory of personality development, the most significant encounters with punishing adults occur in relation to sex and aggression. The memory of these encounters is stored in the *superego*, which comes to serve more or less as a censor to prevent the individual from violating moral norms as he learns them. It is responsible for the feelings of guilt that arise when these norms are violated. The superego also develops idealized notions of good behavior, which may, in some cases, be quite unrealistic.

The id, ego, and superego are Freud's concepts for three different modes of operation for the personality, all of which appear in everyone's behavior.

Although they are frequently at cross purposes, the ego and superego are outgrowths of the id, and depend on the psychic energy of the id for their functioning. As an example of the friction: Assume that tension in the id is aroused from hunger. The id seeks immediate relief (pleasure principle) by forming an image of food. The ego causes the person to wait (reality principle) until an appropriate food object has been obtained, and the superego may dictate certain requirements (e.g., never eat pork, eat fish on Friday, or do not eat out of garbage cans), which limits the ego's degrees of freedom in operation.

One of the consequences of growing older is that more of the impulses of the id must be satisfied in socially approved, indirect ways. Indeed, much of early learning is simply teaching the child what not to do (e.g., do not urinate in public, do not eat off the floor, do not have temper tantrums). The result is a state of conflict, which brings about *anxiety*, which, in turn, leads the person to learn *defenses* against the unpleasant aspects of anxiety.

Freud made the distinction between *reality anxiety* (fear of a real threat), *moral anxiety* or guilt (induced by doing something that is wrong), and *neurotic anxiety* (a fear that the impulses of the id will get out of control). It is neurotic anxiety that leads to the formation of *defense mechanisms*, which may be regarded as tricks one learns to control unacceptable id impulses. Some of the defense mechanisms noted by Freud (repression or denial, rationalization, and projection) were discussed in Chapter 14 as forms of cognitive distortion resulting from emotional encounters. Displacement (substitution of goal objects) was also discussed. Others are *reaction formation, sublimation, compensation*, and *identification*. They are summarized in Table 16.2.

Some of these defense mechanisms are very important in the development and functioning of most adults, since, in general, the only way one becomes an adult (psychologically, that is) is to learn to substitute acceptable behaviors for ones that, as a child, may have been acceptable but which become unacceptable as one matures. Compensation, for example, can be quite adaptive, in that it can provide the motivational force necessary for success in some field if the field is chosen realistically. (One who is tone-deaf should not try to compensate by becoming an opera singer.) Likewise, identification is the primary means whereby the child acquires adult behaviors appropriate to one's sex.

FREUD'S IMPORTANCE

Freud is generally considered to be one of the most important figures in the history of psychology, and particularly, in the study of personality. It is significant that he united several different conceptions of human nature and behavior into a single approach with many ramifications.

The main ideas he integrated include the following: (1) *Psychological determinism*, or the idea that all behavior has a cause, although one is usually not aware of it. This notion was expressed in his book, *The Psychopathology of Everyday Life* (1914), in which he tried to show that even the most inane slip of the tongue, forgotten appointments, etc. were caused by the operation of unconscious processes. (2) The importance of early early experi-

TABLE 16.2 *A Summary of the Major Defense Mechanisms*

Name	*Description*
Repression (denial)	*An unpleasant or threatening thought or idea is not permitted into awareness.*
Rationalization	*A behavior based on an unacceptable motive or cause is explained as resulting from an acceptable motive or cause (e.g., a poor grade explained by poor teaching).*
Projection	*One's unacceptable motives are attributed to another person. (A hostile person comes to believe that other people are "out to get" him.)*
Displacement	*A substitution is made, whereby a less threatening target of a motive is substituted for the more natural target (e.g., anger at one's father is "taken out" on one's little brother).*
Reaction formation	*The individual overasserts a motive that is opposite in character to the one that threatens him (e.g., a person threatened by his own fascination with pornography may become a strong advocate of censorship.*
Compensation	*A personal shortcoming is overcome by an intense effort to become successful in another field (e.g., an unathletic person becomes a sports writer).*
Sublimation	*The most direct expression of an unacceptable motive is denied, and related acceptable behavior is substituted (e.g., dancing as a sublimation of sexual motivation).*
Identification	*One adopts the characteristics of someone who is seen as more powerful or successful in achieving some goal (e.g., boys identify with their fathers because they are more successful and powerful).*

ence in the formation of personality patterns (see the discussion of personality development in the following sections). (3) The relation of imagery, symbolism, and dreams to the operation of unconscious processes. Moreover, he brought together all of the above ideas in the development of a method for psychotherapy, i.e., effecting significant personality change in individuals (see Chapter 18).

OTHER PSYCHODYNAMIC APPROACHES

Other theorists have taken Freud as a starting point and developed their own approaches to personality. Carl G. Jung was a one-time associate of Freud, who objected to Freud's preoccupation with sexual motivation. Jung believed in the importance of the *personal unconscious*, but he also thought there was a *collective unconscious* containing basic ideas common to all men. These ideas, or "archetypes," are to be seen in the commonalities in symbolism and mythology in different cultures. The *mandala*, or circle, for example, has a meaning of wholeness and endlessness in many different cultures, which led Jung to think that the idea must be innate, or a part of the genetic make-up of all human beings. Jung stressed the importance of one's racial heritage as well as his learned motives in understanding personality.

Jung also was the first to focus upon the dimension *introversion-extroversion.* He thought that one's basic orientation relative to this dimension was very influential in determining how one functions psychologically.

Alfred Adler was another associate of Freud who objected to Freud's stress on sexuality. He felt that much of man's behavior was motivated by strivings to be free from feelings of inferiority and to develop a sense of mastery over one's environment. These feelings of inferiority are grouped into what Adler called an *inferiority complex,* which is acquired during infancy when the individual is, in fact, inferior to adults. In order to overcome these feelings, a person may strive for goals that are unrealistic and thereby get into difficulty in the form of emotional disturbances.

Harry Stack Sullivan, another psychoanalyist, focused upon interpersonal processes and believed that behavior could not be understood except in terms of interpersonal relationships. He even defined personality as the sum total of one's interpersonal relationships.

Karen Horney also stressed the social aspects of personality, suggesting that there are basically three orientations: toward other people, away from them, or against them; and that much of adult behavior could be understood as expressing one of these orientations. She also noted that neurotic behavior resulted from the learning of maladaptive patterns of behavior in order to relieve *basic anxiety,* which arises out of the helplessness of childhood and its concomitant feelings of insecurity.

Erich Fromm, even more than the other socially oriented psychoanalysts, stresses the relative importance of social as opposed to biological factors in personality. In particular, he feels that character traits are not simply new ways of expressing old id (biological) impulses, but rather that they are rooted in the experiences one has while growing up in a particular society. Different societies produce different traits, and these traits have little to do with one's biological functioning. He also feels, contrary to Freud, that various human ideals such as justice and freedom are not simply expressions of id urges but represent genuine aims which exist independently of id motives.

In general, then, with the exception of Jung, the later developments within psychoanalysis have increasingly stressed the social basis for personality and have tended to explain adult behavior in social, rather than in biological terms. It should be pointed out that all of these views developed as a result of the clinical practice of psychotherapy. The theorists are, or were, all practicing psychotherapists, rather than experimental researchers. Their main ideas represent their attempts to make sense out of the problems presented to them by their patients.

BEHAVIORISTIC PSYCHODYNAMICS

The almost exclusive reliance upon observations of behavior on the analyst's couch has led some psychologists to question the generality of the theories put forth by these men. One attempt to bridge the gap between psychoanalytic theory and behavior in general was made by John Dollard and Neal Miller (1950). Starting with the basic principles of learning and motivation as developed in experimental psychology (Chapters 7, 12, and 13), they

attempted to show how various kinds of behaviors, both normal and abnormal, could be explained as learned modes of dealing with basic, primary drives such as hunger, thirst, and sex. Some of their work has already been discussed in the chapter on motivation. It will simply be pointed out here that this approach, like the psychoanalytic approaches, stresses the importance of *drives*, or *motives*, unconscious processes, conflicts, and defense mechanisms. For the most part, it is based on principles of learning developed in laboratory experiments rather than on experiences gained in the practice of psychotherapy. For this reason, it has been more popular among research-oriented psychologists.

Behavioristic Theories

Both the trait and the psychodynamic approaches to personality rely heavily on hypothetical internal processes, or dispositions, to explain behavior. Some recent students of personality, however, have objected to the reliance upon such inferred internal processes; instead they have focused upon the objective conditions under which particular behaviors are learned and the detailed specifications of situations in which the behaviors occur.

STIMULUS CONTROL OF BEHAVIOR

One of the most radical departures from the traditional approaches was made by B. F. Skinner, whose important contributions to operant conditioning have already been mentioned in Chapter 7. The approach of Skinner and his followers is radical because it purports to deal with complex behavior without reference to motives, needs, or other hypothetical dispositions within the person. The main principles involved are those of operant conditioning. Thus it is pointed out that behavior which is *reinforced* is more likely to recur, and, in general, that the repetition of behavior depends upon its consequences. The conditions under which reinforcers can be expected are signaled to the person by *discriminative stimuli.* For example, a pigeon is trained to peck a key when a green light is on but not when a red light is on. The light is thus a discriminative stimulus that signals when a peck will lead to reinforcement. The pigeon's behavior is *controlled* (i.e., can be made to occur or not) by the light and by the reinforcement contingency.

Extrapolation to human behavior is not difficult. Consider, for example, the notion of *dependency.* Dependency in a child may be thought of as a motive (psychodynamic approach) that leads to behavior such as clinging to mother at inappropriate times, refusing to go out and play, calling for a drink of water at night, not being able to tie one's own shoes, etc. It may be explained in psychodynamic terms as being due to frustration in the early feeding situation, early maternal deprivation, etc. On the other hand, it may be considered as a set of specific behaviors including those listed above, and analyzed to determine the specific discriminative stimuli and reinforcers that are controlling them.

Take one particular behavior as an example: Clinging to mother when she is trying to cook dinner. Many children do this, to the consternation of many mothers. The usual response on the part of the mother is to pick the

child up and (spending some time with him) scold or spank him. The response, although it is not intended as such, may be reinforcing to the child and, rather than decrease the frequency of such behavior, may actually serve to increase it. The discriminative stimuli might be those associated with the general situation of preparing dinner, which signals to the child that "If I cling to Mother, she will spend some time with me." The net result is a very frustrating situation for the mother and perhaps also for child.

The Skinnerian would see the problem as determining the stimuli controlling the child's behavior and then altering them. Unfortunately, some situations are quite complex, and it is difficult to identify precisely the controlling factors. Nevertheless, at least in principle, the basic elements of the situation can all be described without reference to motivational or dispositional concepts. Furthermore, as will be shown in the next two chapters, the theory works, in that many deviant behaviors can be changed by gaining control of the discriminative stimuli and reinforcements controlling them. In the example given, it would be quite likely that the child's behavior could be changed by the mother's refusal to reinforce it by paying attention. Of course, it is difficult not to pay attention to a child if he is holding onto your leg and you are trying to walk around the kitchen. Finding an acceptable way to remove reinforcers sometimes constitutes one of the most creative aspects of behavior modification techniques.

In summary, Skinner's approach would view human behavior as subject to the laws of operant conditioning, and thus under control of specific stimuli in the environment. Whether or not motives, dispositions, or conflicts exist is more or less irrelevant to the approach, since the behavior can be changed if its present-day environmental consequences can be discovered and brought under control. The broader social implications of this approach are expounded by Skinner in a recent book, *Beyond Freedom and Dignity* (1971).

OBSERVATIONAL LEARNING

Does all behavior that is learned require reinforcement, or can learning take place in other ways? In particular, if would appear that humans do a great deal of their learning without any obvious reinforcement (see Chapter 12), and, indeed, may learn simply by observing other people. Recent work with children by Albert Bandura and his colleagues has shown rather clearly that many behaviors are learned simply by observing them in another person, and without any obvious reinforcement. This kind of learning is called imitative, or observational learning.

In one set of experiments Bandura, Ross, and Ross (1963) had young children watch an adult model displaying aggression toward a large Bobo doll (Figure 16.3). The children, when observed later in the same situation, behaved as the model had behaved. When the child saw the model punished for his aggression, however, there was less imitation than when the model was not punished. In another experiment these same investigators found that when given the choice between a powerful and a weak model (the powerful model had control over the administration of rewards, such as

FIGURE 16.3 *Imitation of aggressive behavior. In the upper sequence, the adult model is attacking the Bobo doll. In the two lower sequences a boy and a girl who watched the model behave in much the same way.*
From Bandura, Ross, & Ross, 1963.

candy, while the weak model did not), children tended to imitate the powerful model.

This research has demonstrated that regardless of the immediate reinforcing consequences, the learning of behavior can occur through imitation. Other research has shown that the performance of these behaviors is rather strictly limited to the situation in which they were learned. To put it another way, the behaviors are under control of rather specific discriminative stimuli. An implication of this research is that an understanding of the complexities of adult behavior may require a rather detailed analysis of the specific behaviors learned in specific stimulus situations.

Bandura has developed a theory of personality in which imitation plays a major role in determining one's behavior. Children imitate adults or not, depending on whether they see the adult's behavior as being rewarded or punished. Maladaptive behavior, which, it is assumed, is caused by faulty modeling at some earlier time, can be altered by new, more appropriate modeling.

GENERALIZED BEHAVIORS AND TRAITS

In addition to specific behaviors learned in specific situations, there are certain behaviors that occur in *many* situations, which might therefore be taken as being caused by an underlying trait or disposition. In the behavior-

ist approach, it is quite possible for a generalized "trait" to develop to the extent that particular behaviors are reinforced in many situations. Take for example the "trait" of aggressiveness (or, if you prefer, the motive called aggression). Many boys are aggressive in a number of situations in which they have been encouraged (perhaps by their fathers) to be aggressive, such as when playing sports, when fighting with other boys, etc. Even so, however, an aggressive boy is often aggressive only in the presence of appropriate discriminative stimuli. He may not, for example, fight with girls. For most traits, one can find situations in which the appropriate behaviors do or do not occur, depending upon the specific stimuli present in the situation. Also, one of the reasons why traits seem to be so general in some individuals is that most people, in fact, do not expose themselves to great varieties of situations. The requirements of most jobs and most types of family life severely limit the range of stimulus situations available. Consequently, particular patterns of behavior learned in those limited situations will appear to be very generally characteristic of that individual, while in reality the "traits" may apply to the situations themselves rather than to the individuals.

In summary, behavioristic psychologists have taken a critical look at practically all of the earlier concepts about personality. They have questioned the applicability of motivational and dispositional concepts for explaining behavior, and have shown in a variety of experiments that behavior is much more situation-specific than was previously thought to be the case. They have suggested that if complex adult human behavior is to be understood at all, it must be in terms of the learning history of the person involved. What are the conditions (observational or reinforcement) under which a particular behavior was learned? What are the discriminative stimuli controlling it? What is the reinforcement that maintains that behavior? If these questions can be answered satisfactorily, then from this point of view, there is no need to refer to instinctual motives, inner conflicts, or generalized traits in order to understand the behavior.

Phenomenological, Cognitive, Self, and Humanistic Theories

Thus far you have encountered approaches which stress that behavior is determined by motives and conflicts, by reinforcements, by traits or dispositions. The emphasis is either on the past, in which the relevant events occurred, or on the future, when the person expects relevant events to occur. Furthermore, the individual is not thought to be aware of most of the determinants of his behavior. We now turn to a group of approaches that focus on the *present*. They note that behavior in the "here and now" is most immediately determined by events in the here and now, and an understanding of personality requires an understanding of how the person perceives, feels, and thinks in the present.

This focus on the present found expression in the systematic work of Kurt Lewin (1935), who suggested the concept of *life space* to include all of the present determinants of one's behavior. Relationships within the life space fluctuate from moment to moment, and thus the determinants of

behavior are not the same from one moment to the next. He suggested that because of these fluctuations, it makes little sense to talk of persistent dispositions. Rather, one should try to understand how the life space is organized at any moment. Such an approach is quite tedious, as you could well imagine. Also, Lewin's language is quite abstract. Therefore, until recently his work had little impact on the whole field of personality theory, except in terms of the basic idea of the importance of the present.

The focus on the present may cause one to examine feelings and perceptions, in which case the approach is said to be *phenomenological.* It may focus upon thought processes—in particular, the way one thinks about other people—in which case the term *cognitive* describes the approach. *Self theories* emphasize one's awareness of his *own* states, emotions, feelings, etc. Some approaches are *humanistic* because they focus upon apparently uniquely human feelings, strivings, values, and experiences. They also deny the validity of abstract conceptions of man in terms of drives, dispositions, and motives derived from animal work, and object to the application of norms, averages, etc., for purposes of describing the individual.

While there is much overlap among these approaches, there are also many differences. Some theories fit into all categories, while others do not. We shall consider a phenomenological self theory, a cognitive approach, and humanistic psychology.

ROGERS' SELF THEORY

According to Carl Rogers (1959) behavior follows from one's perceptions and feelings, in particular one's perceptions and feelings of oneself (or one's *Self*). The concept of Self plays a central role in his theory. It is defined as an "organized, consistent, conceptual gestalt composed of perceptions of the characteristics of the 'I' or 'me' and the perception of the relationships of the 'I' or 'me' to others and to various aspects of life, together with the values attached to these perceptions (1959, p. 200)." If one perceives or values himself negatively, or if he sees his behavior as not being congruent with his self-concept, then the result is tension and maladjustment. Mental health, on the other hand, is a state in which one thinks positively of himself and in which his behavior and his self-concept are consistent.

One way to deal with the incongruities between self-concept and behavior is to deny the incongruous aspects through the use of defense mechanisms in which one fails to perceive oneself realistically. The defense mechanisms are important because they prevent the full experience of oneself in the present, which in turn prevents one from dealing with the incongruities. However, they are not given the same focus as in the case of psychoanalysis, where they play a central role in psychopathology.

KELLY'S ROLE CONSTRUCT THEORY

For George Kelly (1955) the most important thing about a personality is the way one interprets, or *construes*, the world. He considers that people interpret the world in much the same way that a scientist interprets the phenomena in which he is interested. The person develops *constructs*, which are particular ways of interpreting events. An individual's personality, Kelly

argues, is basically determined by the constructs that he has developed, especially those which he uses to respond to other people.

Different people have different constructs, and they may be organized in various ways. For example, for one person, the construct good-bad may be of paramount importance in responding to other people. For another person the construct of "manipulability" may be important. For others, several ones may be of equal importance, with no single central construct.

One's constructs determine how he anticipates events, i.e., the results of his own behavior and that of other people. This process of anticipation is important because present behavior is partly determined by anticipated outcomes. Also, however, it provides the basis for the validation or invalidation of one's constructs. If one anticipates something and it does not occur, then his constructs must be changed to accommodate the new information. This realization of the inadequacy of one's constructs is threatening, and may lead to withdrawal and failure to learn from experience.

Anxiety comes when one encounters events that cannot be accommodated by his construct system. As a defense against the anxiety, one may refuse to deal with the offending events, i.e., repress them. He may also deny some aspect of his construct system that is out of kilter with the events experienced.

Like Rogers, the focus is on what is happening in the present when the individual attempts to reconcile his construct system with reality. However, the processes involved are less perceptual or experiential, and more along the lines of thinking and conceptualization, i.e., the focus is more cognitive than phenomenological.

HUMANISTIC PSYCHOLOGY

In recent years there has developed within psychology a rather looseknit and somewhat controversial organization of "humanistic" psychologists. Humanism as a movement developed originally during the Renaissance as a result of the rediscovery of the ancient art and literature of Greece and Rome. Its thesis was the importance of human capabilities and values, as opposed to abstract conceptions of the nature of man, particularly as handed down in church dogma. In present-day parlance the term refers somewhat more narrowly to concern with human values, capabilities, and, in particular, expansion of the individual's awareness of his own sensations and feelings and self-understandings, especially of a nonintellectual sort.

As a rationale for the apparent anti-intellectualism of the movement, it is pointed out that man, particularly Western man, has for too long stressed intellectual as opposed to emotional and phenomenological development. Something needs to be done to restore the balance. Abstract conceptions of human nature thus take a back seat to directly experienced realities. Thinking is deemphasized as the supreme human activity, and feeling is elevated in importance.

This movement has incorporated strands ranging from the existential philosophy of Sartre and Camus to the Eastern mystical traditions of Zen Buddhism. The existential philosophers, denying the validity of abstract

conceptions of the nature of man, say that man simply *is*. He becomes what he will, and at any moment in time is in a state of growth toward whatever he wills to become. Proponents of this view include Carl Rogers, already mentioned, and Rollo May.

The Eastern mystical tradition emphasizes the importance of one's becoming aware of the "deepest" aspects of his own being and experiencing "the infinite" through various meditational procedures. Verbal communication *about* one's personality is quite difficult, if not impossible, and can be accomplished only in highly metaphorical terms if at all. All one can do is describe his feelings and experiences, and the humanistic psychologist assumes that these descriptions are the best information about the person available. They generally reject the use of subtle tests for underlying traits or motivational conflicts that are presumably unconscious, relying quite heavily upon whatever experiential information is available to the person at the moment.

Nonverbal communication between people is considered to be quite important. Fritz Perls, who developed an approach to psychotherapy known as Gestalt therapy, pointed out that although one may not be able to verbalize his state, it will be expressed in such nonverbal means as postures, gestures, etc. The term "body language" (Fast, 1970) has been used to apply to this type of communication. Before his death Perls was quite active at the Esalen Institute in Big Sur, California, where efforts focused upon methods for expanding people's awareness of their own experiences and feelings and for enhancing interpersonal communication.

The nonverbal and nonintellectual focuses of this approach have created some consternation among more traditionally oriented psychologists, who feel that scientific advances in the field of personality depend upon being able to express important notions verbally and intellectually. Furthermore, the tendency to include Eastern mystical notions within its purview has not helped in reaching a rapprochement with traditional psychology. In defense it should be pointed out that psychology as we know it is primarily a product of Western civilization, embodying Western philosophies, which emphasize the rational nature of man and of knowledge. Even Freud, who noted the irrationality of the id, seemed to regret the fact, and considered that it interfered with adequate functioning. Man, however, is both Western and Eastern, rational and irrational, intellectual and emotional, and a prematurely narrow and restrictive view of the possibilities for developing this approach to personality would appear to be unwise at the moment. It may be possible, at some point in the future, to translate some of the humanistic conceptions into more traditional language.

COMMENT

You have by now encountered a number of different approaches to personality. If you are inclined to seek to integrate diverse phenomena, you may have wondered whether they are all *that* different. Or, if you respond more to differences in positions, you may wonder whether there is any hope for a single, scientific conception of personality. It may help to consider personality theories in terms of the story of the blind men and the elephant. Each

man, when asked to describe the beast, felt a different portion of its anatomy and thus came up with a different description. Different personality theories, like the men, focus upon different aspects of human functioning and thus should not be considered as competing conceptions of the "truth." It may be true that motivational conflicts are important in behavior and that behavior is controlled by specific discriminative stimuli. One's direct experiences, including the experience of discriminative stimuli, may be quite important in personality. We may hope that at some point in the future it will be possible to use all of these points of view in some fashion to develop an integrated view in which motives, dispositions, perceptions, cognitions, feelings, and behavior are related.

Personality Assessment

Regardless of how personalities are construed, or whether one's purposes are making clinical judgments or doing research, it is essential that one be able to *assess* (i.e., measure) individuals for relevant characteristics. This is true whether the focus of interest is traits, motives and conflicts, behavior, cognitions, or feelings. Furthermore, as is the case for other types of measurement, any assessment procedure should be both *reliable* (consistent) and *valid*—it measures what it is supposed to measure. (You should review the section in Chapter 2 dealing with these concepts, for they are quite important in understanding some of the problems in personality assessment.) An assessment procedure that is neither reliable nor valid is useless.

There are many different procedures for assessing personality. Some are fairly closely tied to particular theories of personality, while others are less theoretically oriented. The following section is organized according to the main theoretical lines set forth in the previous section. However, one should keep in mind a particular procedure may be relevant to several different approaches.

Assessment of Traits

Measurement of traits in individuals is usually based on tests in which the subject answers specific questions about himself, the answers being sharply limited by the instructions. For example, R. B. Cattell, whose trait theory of personality was discussed in the previous section, has developed a test to measure the 16 traits described previously (Table 16.1). The test is called the "16 PF" (PF is for personality factors) test, and consists of 187 items such as "I like to watch team games." The subject responds "Yes," "Occasionally," or "No" to each item, according to whether he thinks it is true of himself. Each of the 16 factors is measured by from 10 to 13 items, and the score on the factor is the number of specific items that the subject thinks apply to him. A sample test profile, or graph showing a pattern of scores, is shown in Figure 16.4.

A similar test is the California Psychological Inventory, which provides a score on 18 traits such as sociability, tolerance, and responsibility. Both of

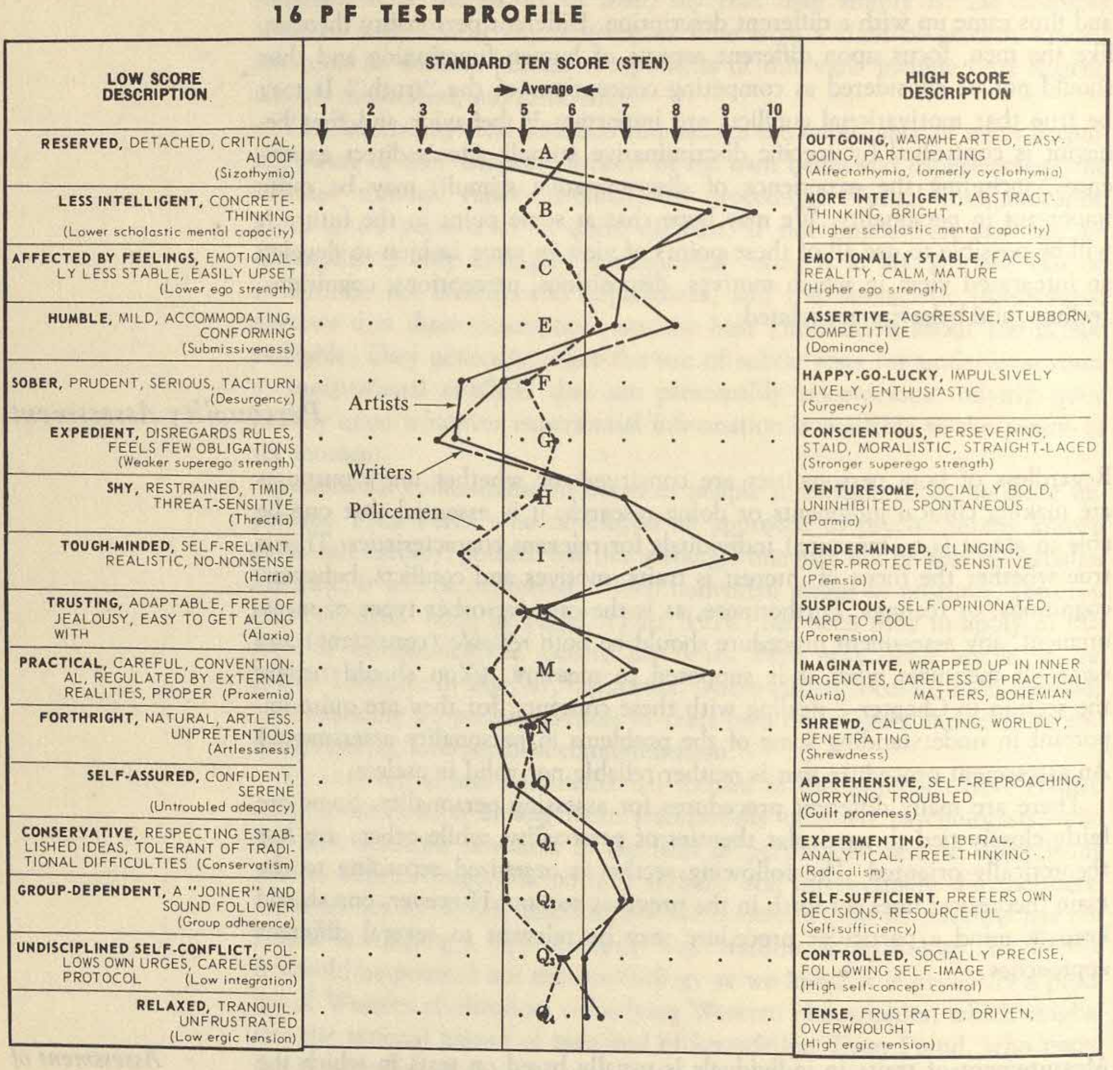


FIGURE 16.4 *Two profiles for the 16 PF personality test. These profiles are average scores obtained on the scales by artists, writers, and policemen. An individual's profile would look somewhat the same.*
From Cattell et al., 1970.

these tests are multidimensional, in that they attempt to give a relatively complete description of personality.

Another multidimensional test is the Minnesota Multiphasic Personality Inventory (MMPI). This test, which is also designed to measure traits, is widely used in clinical practice because it describes traits in terms of various personality disorders. There are 566 items such as "I wish I were not so awkward," to which the subject responds "True" (of himself), "False," or "Cannot say." The scales or traits comprising the test are shown in Table 16.3, together with a brief description of the type of symptoms one would

TABLE 16.3

The Main Clinical Scales of the MMPI and Their Interpretation

Scale	*Interpretation*
Hypochondriasis (HS)	*Overconcern with one's health; pessimistic outlook and exaggeration of minor physical symptoms.*
Depression (D)	*Pessimistic outlook; feelings of lack of personal worth; hopeless feelings.*
Hysteria (Hy)	*Denial of problems; tendency to have ailments with no identifiable physical basis.*
Psychopathic deviation (Pd)	*Tendency to devalue social norms and to be shallow in interpersonal relations.*
Masculinity-feminity (Mf)	*Measure of sex-typing of interest patterns.*
Paranoia (Pa)	*Tendency to suspect others' motives and to believe in existence of plots against oneself; to interpret irrelevant events as relating to oneself.*
Psychasthenia (Pt)	*Tendency to have recurrent irrational thoughts and urges to perform irrational behaviors; compulsivity and phobic tendencies.*
Schizophrenia (Sc)	*Tendency toward withdrawal, bizarre thoughts; and hallucinations.*
Hypomania (Ma)	*Excitement, elation, and feeling "high" with no particular reason.*
Social introversion (Si)	*Tendency to avoid other people.*

expect from a person scoring high on each. A normal profile and one produced by a psychotic patient are shown in Figure 16.5.

Other tests measure only one or two isolated dimensions of personality. Many of these tests are used in research rather than for the assessment of individuals for clinical purposes. For example, recall Rokeach's (1960) dogmatism scale and Christie's (1970) Machiavellianism scale. Another dimension is authoritarianism, measured by the California *F* Scale (*F* = fascism), developed by Adorno and his colleagues (1950).

EVALUATION OF TRAIT MEASURES

There are many advantages of the paper and pencil tests mentioned in this section. One of them pertains to the objectivity with which the answers are scored, the structured nature of the questions, and the limitations as to permissible answers. These characteristics promote ease of administration and increase the likelihood that different investigators will get similar scores from a given subject, since subjective interpretations are minimized.

The reliability of such tests, while not as high as for, say, a good intelligence test such as the Stanford-Binet, is generally higher than for other types of personality tests. Their validity, however, depends on the method of standardization. The validity of the 16 PF test, for example, depends on the adequacy of the factor analysis on the basis of which the factors were derived, and the extent to which the items of the test relate to the factors. Sometimes different factors are found using different testing or statistical

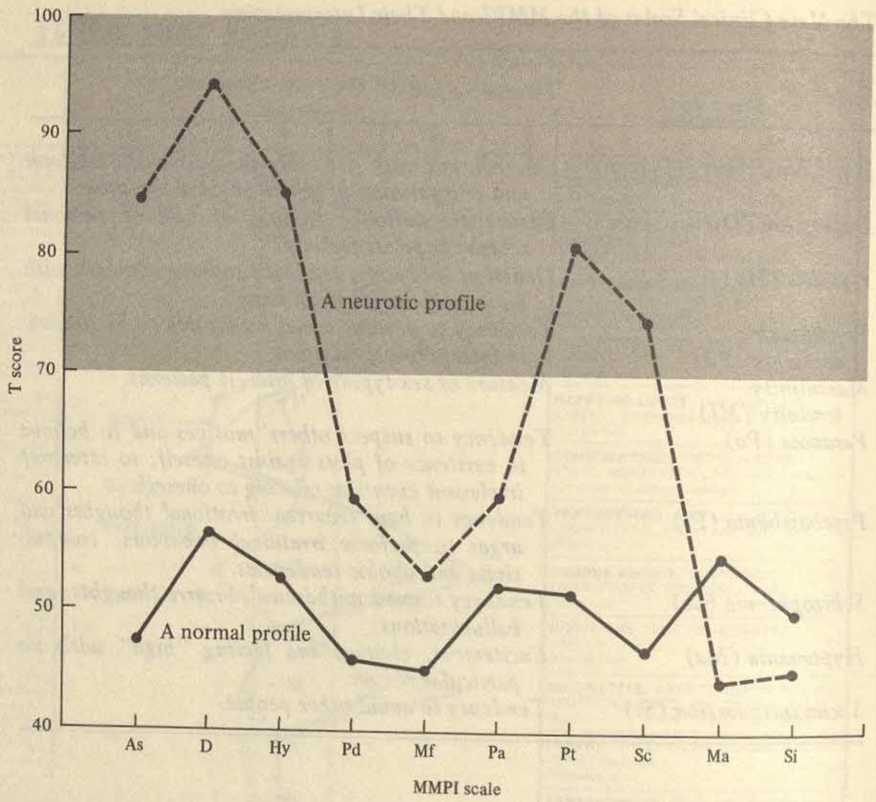


FIGURE 16.5 *Two MMPI profiles, one from a normal individual and the other from a neurotic person. The scores on each of the scales are transformed into T scores so that each one has a mean of 50 and a standard deviation of 10. Scores falling in between 40 and 60, i.e., within one standard deviation of the mean, are considered to be in the normal range, and scores falling outside this range are deviant. Elevated scores on the "neurotic triad" of Hs, D, and Hy, with a secondary peak on the Pt scale are often found in neurotics.*

methods so that one can always question the "reality" of a given set of factors.

The MMPI scores are ultimately based on the validity of psychiatric diagnosis, since the items were selected on the basis of their ability to differentiate between "normal" individuals and hospitalized patients exhibiting the symptoms making up the various scales of the test. As you will see later, there is evidence that such clinical diagnosis is questionable, and should hardly be the basis for an "objective" personality test. On the other hand, there has been a great deal of research investigating the validity of the scales of MMPI—assessing them against other criteria of a more objective nature, and much of it has been successful. It is safe to say that this test is probably the best of those trait tests available for clinical purposes.

Single-factor tests have been subjected to much research, and the results are mixed. In some cases it seems questionable that the traits measured apply to a given individual in all situations. For example, in one experiment

persons scoring high on the Machiavellianism scale were manipulative in some situations but not in others (Bird, 1971).

All of these tests are potentially affected by the particular response style of the subject. Some subjects tend to give answers that they think are "socially desirable" (Edwards, 1957), while others may have a tendency to acquiesce (to say "Yes" rather than "No," or vice versa). Although it is possible to design items minimally subject to these biases, it is not possible to rule them out completely.

Many clinicians believe that the rigid structure and the limited number of possible responses make the tests completely insensitive to the "richness" of an individual's personality. This is a difficult criticism to evaluate, since methods for assessing the "richness" are themselves, to a considerable degree, subject to some of the limitations that have already been discussed.

Psychodynamic Assessment

Psychodynamic approaches to personality emphasize the importance of underlying motives and conflicts that are, for the most part, unconscious. Assessment procedures, predictably, are thus aimed at "uncovering" these processes, and the favorite methods are the *clinical interview* and *projective tests*.

THE CLINICAL INTERVIEW

In the interview the patient or subject talks about himself to the examiner and answers questions aimed at the discovery of areas in which conflicts might be present. He may be asked to describe his dreams or to free associate (say whatever comes to mind without first evaluating it). Dreams, free associations, and other "unedited" material are important to the psychodynamically oriented psychologist because of the clues they may provide about unconscious motives and conflicts. The psychoanalytic literature is full of clinical interpretations of particular dream and free association materials, and they play an important role in psychoanalytically oriented therapy (described in Chapter 18).

The interview also provides the opportunity to observe directly the patient's behavioral reactions to particular stimuli such as words that might symbolize a hidden conflict. Even though his verbal response might be of little interest, subtle movements, starts, etc., may indicate the emotional content of the stimulus.

While interviews can be structured, in that a particular set of questions is asked, they are usually quite flexible, with the examiner adjusting his questions in accordance with the patient's responses. Unfortunately, this procedure opens up the possibility that the examiner may, by his response to the examinee's behavior, reinforce certain kinds of responses and not others, depending on their congruence with the examiner's theoretical bias.

Regardless of the methodological difficulties inherent in the interview, it is safe to say that this form of assessment provides much of the material for the clinician's interpretation of the patient's problem in terms of his motives and conflicts. On the positive side it is likely that information can be gotten from the interview that cannot be obtained in any other way, at least not as

directly. Although some psychologists may be suspicious of any overt statement by someone about himself, others (e.g., Kelly, Rogers), take at face value what the patient says about himself.

PROJECTIVE TESTS

Projective tests present the examinee with unstructured tasks of various sorts in which he must produce a response that is at least partly derived from his own imagination. The term "projective" implies that in dealing with the unstructured situation, he somehow "projects" his own feelings, motives, and conflicts into it. Although he may not be aware of them directly, they provide the basis for his attempts to structure the situation and make a response. The two most famous projective tests are the Thematic Apperception Test (TAT), which was mentioned in Chapter 13, and the Rorschach ink-blot test, which was developed by the Swiss psychiatrist, Hermann Rorschach.

The Rorschach test consists of 10 cards, each containing a bilaterally symmetrical ink blot. Some of the cards are black and white, and some are colored (Figure 16.6). The examinee is shown each card in turn and is asked to tell what he sees in it, or what it reminds him of. Then, after going through all the cards, he is asked to describe what it was about the card that made him think of the response. For example, a frequent response to one of the cards is "It looks like a bat," and most people see a bat because of the outline shape of the blot and perhaps its texture. Other responses might be determined by the color of the blot. The idea is that the content of the response may indicate in some way the areas of concern to the examinee, while the determinants (color, texture, or form) may provide additional information, such as whether he exerts a lot of self-control, is emotionally relaxed, is dependent, etc.

While Rorschach went to great pains to select ink blots that were responded to differently by normal and psychopathological subjects, subsequent research has been mostly disappointing in assessments of the reliability and validity of the test. Although there are reasonably objective ways to score responses, so that the extent of agreement by different examiners is increased somewhat, clinicians tend not to agree among themselves as to the details of an examinee's conflicts, problem areas, etc., on the basis of the Rorschach.

Actually, there is some evidence that clinicians tend not to agree with each other, even when given additional information about the patient. In one study (Little & Schneidman, 1959) clinicians were given Rorschach, TAT, and MMPI scores as well as case history information about a number of examinees. As it turned out, there was little agreement among the experts with regard to the personality dynamics of the subjects. Other investigators have produced essentially the same results (Mischel, 1971). Thus, interjudge reliability is rather poor. The same problems are found when patients are assigned to different psychopathological groups. For example, clinicians usually agree as to whether or not a patient is psychotic, but they are less likely to agree upon a more differentiated diagnosis, e.g., the particular type of schizophrenia or neurosis (Zeigler & Phillips, 1961). Does more information enhance the reliability of judgments? Actually, the only information

(a)

(b)

FIGURE 16.6 *The Rorschach and the Thematic Apperception Test. One card from each is shown.*

that seems to make much difference in evaluating patients is biographical data (Soskin, 1959), which, interestingly enough, can be utilized just as well by student nurses as by trained clinicians.

Given the research findings, one wonders about the meaning of the coherent stories about the inner dynamics of patients woven by clinicians working in the psychodynamic tradition. That is about all one can do at the present—wonder.

Behavioristic Assessment

Since the behavioristic approaches to personality emphasize the learning of specific behaviors, rather than the operation of broad underlying motives and dispositions, assessment is made in rather specific behavioral terms. Usually, the behaviors noted are those of which the patient or someone else has complained, and behavioral change is the goal. An attempt is made to learn as much as possible about the situations in which the target behavior occurs, with an emphasis upon quantification, i.e., counting and measuring the behavior in question. This kind of assessment, of course, is based on the theoretical assumption that present behavior is the result of previous learning. That is, what one does in the present is the result of particular patterns of reinforcement that occurred in the past, or the influence of particular models for imitation at some previous time. The focus, however, is on specific behaviors.

As an example of this approach, Lovaas and his colleagues (1965) devised a method for noting on a permanent record particular classes of children's behavior, including the times at which they occurred. "Crying," "hitting," "examining a toy," etc., are such classes. In one case a severely disturbed girl was observed. She was quite self-destructive, and would pinch and slap herself, beat her head on the floor, set her hair on fire, etc. Careful observations, precisely recorded, indicated that the destructive behavior seemed to occur when reinforcing behavior from other people (smiling, nodding, etc.,) did not occur when she expected it to. Reinstating the reinforcers resulted in a reduced frequency of self-destructive behavior.

Specific fears have been assessed by measuring how close a person would approach to a feared object. For example, Bandura, Grusec, and Menlove (1966) studied the fear of dogs in children by measuring how close a child would come to a dog which was placed in a pen in the same room.

Patients themselves (or their parents, in the case of young children) may be asked to keep rather complete records of their own behaviors, particularly those involving undesirable symptoms, and to note the time and circumstances of their occurrence. It has been found that careful, specific, quantitative analysis of the behavior and its circumstances has often revealed clear relationships between specific conditions (discriminative stimuli and reinforcements) and the behavior in question. Statements about underlying motives and conflicts are considered to be irrevelant, since the behavior can usually be modified by modifying the reward contingencies in the environment.

EVALUATION

How well can one person observe another's behavior? This question is critical for an evaluation of the behavioristic approach. The best way to answer the question is to compare one person's observations with those of another. While the interobserver reliability in the identification of specific behaviors is not perfect, it is usually quite high—much higher than the extent of agreement between clinicians in the psychodynamic assessment of motives and conflicts. Whether the behavior itself is consistent or not is, of course, not really applicable, since only consistent behaviors can be dealt with by this approach. The validity of the assessment procedure is determined after the fact, once the environmental contingencies presumably controlling the behavior are manipulated. If the behavior changes as predicted, as it does in many cases (see Chapter 18), then the assessment was valid.

This approach is criticized for its focus upon behavioral symptoms rather than the "causes" of behavior (i.e., motives). However, proponents of the approach point to successes in treatment, and argue that such concern is inappropriate since we actually know so little about the internal causes of behaviors.

Phenomenological Assessment

The phenomenological emphasis is on the way the person experiences himself and other people; therefore, assessment in these terms requires finding out about one's experience. Since experience is private, studying it is one of the knottiest problems in psychology. However, as pointed out in Chapter 1, learning about another person's experience is an important task for psychologists, even if the methods are necessarily indirect.

THE INTERVIEW

The simplest way to find out what another person is experiencing is to ask him. Although psychodynamically oriented psychologists would argue that such a direct approach would produce only misleading data, one should remember that phenomenological theorists take the person at face value and therefore must take seriously his statements about himself. Actually, the clinical interview is used in both approaches, but the manner of interpretation, whether the statements are taken at face value or interpreted in terms of unconscious processes, is different.

THE Q SORT

The Q sort is an elaborate and systemic way of assessing private experience. The examinee is given a large number of cards, each containing a statement such as "I am lazy" or "I am easy to get along with." He then sorts them into several piles, usually from 7 to 11, according to whether he thinks they are most characteristic of him, least characteristic, or in between. Sometimes the number of cards that must be put in each pile is specified by the examiner such that the extreme piles get only a few statements and the middle piles are used more often. The frequency required for each pile is selected so that the distribution of statements as a whole is a normal distribution (see

Chapter 15). One hundred cards might be sorted into 11 piles, as shown in Table 16.4.

Since some of the statements are positive and some are negative, it is possible to get some quantitative evaluation of the person's self-regard by examining which statements are placed in which piles. The *Q* sort can also be made according to how the examinee would like to be (i.e., his ideal self) or how he perceives some other person. It has been used to study changes in patients' evaluations of themselves during the course of psychotherapy, particularly by therapists working within Carl Rogers's framework.

The *Q* sort is one of a number of assessment techniques using what is called *self-report,* i.e., the examinee responds to statements about himself. Such techniques are, of course, not unique to phenomenological assessment, since you encountered several of them earlier in the discussion of trait assessment. Whether a technique presumably assesses how one feels about himself or whether he has certain personality traits depends on the use to which the responses are put. In phenomenological assessment the responses are taken at face value, while in trait assessment a given response simply contributes to a score on a given (inferred) trait.

EVALUATION

As in the case of behavioristic assessment, phenomenological assessment procedures have been criticized by psychodynamically oriented psychologists because they do not get at the "depths" of the functioning personality, but rather consider only surface manifestations—those statements that the examinee makes about himself. Since, however, the person's statements *must* (according to the theory) be taken at face value, the criticism is not exactly applicable to the procedure but rather to the overall approach itself.

The *Q* sort technique has a reasonably high reliability since subjects tend to make the same sorts from one occasion to the next. Its validity can only be indirectly determined, however. For example, when patients going through psychotherapy show increasing consonance between their ideal and real selves as determined by the method, then there is at least indirect evidence that something of importance is measured.

Interview techniques are subject to the same criticisms as were mentioned earlier in connection with psychodynamic assessment, except perhaps less so, in that there is less emphasis upon *interpreting* what the patients says and more emphasis upon accepting it as descriptive of the patient.

TABLE 16.4 *A sample Q-sort distribution*

Pile number	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Number of cards	*2*	*4*	*8*	*11*	*16*	*18*	*16*	*11*	*8*	*4*	*2*
Description (characteristic of person)		*Least*				*Neutral*				*Most*	

Cognitive Assessment

Attempts to differentiate phenomenological from cognitive assessment procedures are probably somewhat arbitrary. The theoretical focus is somewhat different in the two cases. The phenomenological approach emphasizes the more direct perceptions and feelings about oneself and others, while the cognitive approach focuses upon an individual's "cognitive structures" (see Chapter 11), which determine how he thinks about himself and other people. Two procedures that fit within the cognitive approach are the *Semantic Differential* and the *Role Construct Repertory* (REP) test.

The Semantic Differential was mentioned in Chapters 8, 10, and 14. It yields three scores for each stimulus that is rated: evaluation (good-bad), potency (strong-weak), and activity (active-passive). As you might expect, the examinee can rate himself or other people with this technique, just as he can rate words or other stimuli.

The REP test is aimed at finding out the dimensions or scales that the examinee uses in thinking about other people. He is asked to name people who have certain relationships to him, such as "a teacher you liked," "your father," etc. After naming people who fill 20 or 30 such roles, groups of three persons are selected and the examinee is asked to say which two are alike in some important way and, at the same time, different from the third. For example, two persons may be alike in that they are both conservative in their thinking, and different from the third, who is radical. Thus the dimension conservative-radical is defined as important to the examinee. He responds to 20 or 30 such groups and thereby specifies 20 or 30 such dimensions. These dimensions, according to George Kelly, who developed the test, are important in that they indicate the way the examinee responds to or construes other people.

There are other tests that are aimed at identifying people with particular *cognitive styles,* or ways of perceiving people. For example, whether one person responds to others in a concrete or an abstract way—a dimension stressed as important by Harvey, Hunt, and Schroder (1961)—can be assessed by two procedures, the Conceptual Systems Test and the "This I Believe" Test. The Conceptual Systems Test is a structured test that is scored objectively, while the This I Believe Test asks the subject to write a statement beginning, "This I believe about . . ." Various topics such as God, love, etc., are used, and the answers are scored according to certain criteria that yield an indication of the level of abstraction at which the person is apparently functioning, i.e., from Level One (concrete) through Level Four (abstract).

EVALUATION

As in the case of phenomenological assessment, it is hard to evaluate the assessment procedures and the approach separately. The REP test, directly derived from Kelly's theory, apparently provides a systematic assessment of the significant dimensions of an individual's response to other people. Whether it "really" measures such dimensions cannot be determined without a great deal of research in which the relationship between REP test behavior

Institutionalized Personality Testing: Pro and Con

There is a large demand for personality testing. Almost everyone would like to know more about the people they have to work with, be taught by, or marry, and being able supposedly to predict behavior is a highly valued skill. In response to the demand to learn more about other people, scores of personality tests have come onto the market. Many of them purport to help people in finding out about their or other people's innermost motivations, hidden conflicts, etc.

Many institutions use personality tests for screening purposes, particularly for prospective employees. Rising young executives may be subjected to batteries of personality tests to help decide whether their motives, values, interests, etc., are compatible with success in their particular company. Applicants for professional training programs may be given personality tests to see whether their characteristics are likely to lead to success or to failure. In general, it is the rare individual who will escape some form of personality testing during his lifetime.

This focus upon testing has been somewhat controversial, and both favorable and unfavorable opinions have developed about it. On the positive side it might be argued that any information that one can get about himself or someone else in whom he is interested will be potentially useful, in that it will help him to find situations in which he can best realize his potentialities. From the employer's point of view it is argued that testing provides information that can avoid expensive training programs for employees who are not likely to "work out" in the long run, or who might be prone to accidents. After all, a test is a sample of behavior that is used to predict behavior in some other situations, and any information that enhances this prediction is potentially useful. Another point is made often that since most of the tests which are used are objective tests, they are not subject to the built-in biases inherent in other forms of prediction such as interviewing. Predictions will *be made, whether on the basis of personality tests or on some other basis, and they might as well be made on the most objective basis possible.*

The hitch comes in when the negative side of the question is aired. First of all, there is the question of the validity of the tests in question. That is, how well does a score on a test predict behavior for a given individual? The answer for most personality tests is: not very well at all. It is generally agreed that little can be said about an individual on the basis of only one personality test, even one of the better ones such as the MMPI, the California Psychological Inventory, and the 16 PF. Clinicians have learned that test data are useful only when supplemented by other data, including sub-

jective impressions. (Indeed, some clinicians deny the usefulness of personality assessment on any *grounds.)*

Research studies in which personality test data are used to predict behavior in laboratory situations (that are usually controlled much better than "real-life" work situations) often find that only about 10 percent of the variability in behavior between individuals is predictable from personality test scores. (Indeed, only about 35 to 50 percent of the variability in scores from one test-taking situation to the next is accounted for by a person's "permanent" traits.) One of the reasons for this poor showing is thought to be the fact that human behavior is often much more controlled by the situations in which individuals find themselves than by relatively "permanent" personality traits (see the discussion in this chapter). The test-taking situation only rarely approximates the situation in which the relevant behavior is supposed to occur. In other words, according to this argument even a good test would not be very likely to predict behavior very well in a number of different situations.

Although it is conceivable that an industrial psychologist might construct a test for the specific purpose of predicting success in a particular company, and that the test would be a valid one, this practice is actually quite rare. One of the reasons is that proper test standardization would require that all applicants who take the test be hired without regard for test scores in order to permit the differentiation between high and low scorers. Obviously, this procedure would be very expensive and not popular with cost-conscious managers.

The second major concern with testing is the issue of one's privacy. Personality tests are considered by some to be an invasion of privacy. One questions the extent to which a prospective employee should be required to reveal aspects of himself that may have no bearing upon his performance in job situations but which are requested by the tester. Suppose, for example, that a test actually does *measure a person's unconscious motives and conflicts, but the person taking the test does not know this. If he were asked to consent to the laying bare of his psyche, he would likely refuse. However, he is rarely given the choice.*

Related to the issue of privacy is the problem of maintaining confidentiality of personality test results. How can a person be sure that test information will not be used at some later point to his disadvantage? Psychologists who subscribe to the American Psychological Association Code of Ethics know that confidentiality must be maintained. However, what about the personnel tester who does not subscribe to that code? What then?

However, let us return to the other side of the argument. There are *job situations in which the success or failure of a venture could depend in a very important way on the personalities of key people. For instance, teachers of very young children should presumably have certain characteristics and not others; a receptionist in a company whose success depends in many ways upon public confidence in the competence of its employees should be able to project that competence in his or her contacts with the public. If a manager*

trainee is about to embark on an expensive and difficult training program, then it is important to know whether he is likely to stick to the job long enough for the company to benefit from its investment.

Decisions about such people will *be made, whether on the basis of personality tests or not. If tests increase the likelihood, even to a small extent, that correct decisions will be made, then why not use them? To what extent is it any more an invasion of privacy to use a personality test to make inferences about a person's behavior than to use subjective impressions from a job interview to make similar inferences? Surely one's privacy is not so sacred that others should refrain from attempting to predict his behavior. If the tests are not as valid as they might be, then a proper aim would seem to be to try to improve the tests, rather than to do away with the idea entirely.*

These issues are all very debatable, and there are no ready answers to the problems. From your own point of view you should be aware of the issues involved. Many of them are, and will continue to be, relevant to matters of public policy, law, courtroom evidence (e.g., can a psychologist be compelled to testify in court about a client, thereby violating the ethical code of confidentiality?), and equality in employment opportunities.

and other kinds of behavior is determined. The same comments apply to Harvey's tests for the level of cognitive functioning.

Personality Development

The study of personality development has in many cases cut across the various theoretical approaches previously discussed. Developmental psychologists have borrowed from all of the approaches, so a neat separation according to approach is not possible. This is true in spite of the fact that theorists, particularly Freud, have had much to say about how development was supposed to occur. Students of development have focused instead upon particular issues. Two of these issues are, broadly speaking, the identification of stages of development and the relative role of biological (genetic, physiological, constitutional, and maturational) and learning processes in development.

Some theorists such as Piaget, discussed in Chapter 11, believe that development proceeds in rather discrete stages and that the process in one stage is more or less qualitatively different from that in another stage. Other investigators think that the stages are only apparent and emphasize the learning of specific behaviors as permitted by the stage of maturation of the neural structures involved. You will see some of both approaches.

Freud's Theory of Psychosexual Development

Freud's theory is based upon the idea of developmental stages, with the different stages reflecting different ways of satisfying sexual motives (i.e., the different ways libido is expressed). The first stage is the *oral incorporative* stage, followed by the *oral aggressive* (biting) stage, during which time sexual gratification is accomplished first by taking things into the mouth and then by attacking them orally. The *anal expulsive* and *retentive* stages follow, when sexual gratification is achieved by expelling feces, and later by retaining them for a period of time.

Next is the *phallic stage* (from the Greek *phallos* for penis), when gratification comes from stimulation of the genitalia. The phallic stage leads into the *Oedipus complex* in boys and the *Electra complex* in girls. Boys presumably develop a sexual craving for the mother and, along with this is a fear of being castrated by the father, who is the main competitor. The situation is resolved by identifying with the father and repressing the desire for the mother. A girl is supposed to develop a craving for her father, as well as envy for his penis (she assumes that hers has already been removed by her mother). She solves the problem by identifying with her mother, but, since the castration anxiety is not there, she does not repress very strongly her attachment to her father. Rather, she continues to be affectionate toward him.

The next stage is the *latent period,* during which sex-role behaviors and other socially reinforced behaviors are learned but not much else happens. During puberty, however, many of the old conflicts are regenerated because of the physiological changes accompanying maturation of the sex organs, and many personality problems begin here. If, however, the person acquires some socially acceptable way to gratify his sexual impulses, he goes into the *genital period,* which is true adulthood.

Freud thought that many people remained *fixated* at some earlier stage of development, which means that they achieve sexual gratification in ways that are more appropriate for an earlier age. Nail-biting, smoking, excessive drinking, excessive dependency, and gullibility are adult behaviors which presumably indicate fixation at the oral stage. Disorderliness and miserliness are indicative of fixation at the anal expulsive and retentive stages, respectively. Phallic stage fixation leads to exhibitionism, voyeurism (peeping Tom), dirty jokes about sex, and masturbation. Failure to negotiate the Oedipal stage results in antipathy toward members of the opposite sex and consequent inability to assume normal sex roles.

Some modern research has a direct bearing on Freud's notions. For example, in studies of infant behavior White (1967) notes that rather than being apparently oral individuals, infants from 2 to 6 months of age are more aptly described as "visual-prehensory creatures." He notes that "We observed subject after subject spend dozens of hours watching first his fists, then his fingers, and then the interactions between hands and fingers. Thumb-sucking and mouthing were rarely observed except for brief periods when the infant was either noticeably upset or unusually hungry (p. 207)." These observations would seem to contradict Freud's notions.

Similar contradictions are seen in the research of Harlow and Zimmerman

(1959) with baby monkeys taken from their mothers. When given the choice between a wire model mother with a nipple that provided milk and a terry-cloth-covered model that provided warmth and contact comfort, the infants chose the cloth model. They would approach the wire model only when hungry and would stay there only long enough to eat.

Other research bears upon some of the implications of Oedipal difficulties suggested by Freudian theory. For example, it is assumed that boys without a father in the home will be less likely to adopt appropriate sex-role behaviors. While this seems to be the case for younger boys, one study showed no difference in sex-role behaviors in adolescent boys whose fathers were present and those with fathers absent. Indeed, boys whose relationships with their fathers was judged to be close were more likely to be homosexual than those rated as less close (Greenstein, 1966).

Erik Erikson: Stages of Psychosocial Development

Erik Erikson, also a psychoanalyst, has expanded upon Freud's notion of stages of psychosexual development. In Freud's conception the stages were related primarily to biological development, whereby different modes of gratification of the instinctual motives come about through maturation. Erikson has noted that progress through the stages involves a number of crises, called *psychosocial crises,* in which the individual encounters social institutions and expectations about his own behavior. Successful resolution of the crisis leads to continued growth, while failure inhibits growth. Erikson's stages are indicated in Table 16.5. Note that they continue through adulthood and on into old age.

Erikson's ideas are quite popular, particularly because they stress the importance of continued growth and deemphasize the idea that one's personality is mostly "set" on the basis of early experience. They seem to many psychologists to be particularly pertinent in understanding the main problem of adolescence, which Erikson characterizes as an identity crisis. The teenager must learn "who he is," which means finding some appropriate person with whom to identify, and failure to do so may result in difficulties in adulthood. (See Table 16.5.)

Stages of Moral Development

Kohlberg (1963) has proposed that the development of moral principles proceeds in stages. He gave children of various ages questions such as "Is it better to save the life of one important person or a lot of unimportant people?" and evaluated their answers. He found that the type of answer could be divided into six categories, based upon the differences in moral principles expressed. He inferred that the categories reflected the six stages in moral development shown in Table 16.6. Furthermore, if the stages reflected by the children's answers are examined in terms of the age of the child, a clear developmental trend is shown (see Figure 16.7). Kohlberg's position is that the progression through the stages is dependent upon maturation.

Stages of Psychosocial Crises, According to Erickson TABLE 16.5

Age	*Stage (Crisis)*	*Description*
1	*Trust-mistrust*	*Effective, adequate care leads to trust; improper, inconsistent, or inadequate care leads to mistrust.*
2 to 3	*Autonomy-doubt*	*Consistent discipline, encouraging by parents, independence permitted leads to autonomy; Inconsistent discipline, over-protection, and no independence leads to self-doubt.*
4 to 5	*Initiative-guilt*	*Encouragement of outside activities, questions, etc., leads to initiative in seeking new experiences; restrictions lead to guilt feelings for taking initiatives.*
6 to 11	*Industry-inferiority*	*Encouragement at industriousness leads to later industriousness; over-criticism of mistakes leads to feelings of inferiority, poor task orientation.*
12 to 18	*Identity-role confusion*	*Integration of previous experiences leads to sense of identity; failure to integrate leads to confusion in roles.*
Young adulthood	*Intimacy-isolation*	*Sense of identity necessary for development of ability to share with others. Failure leads to isolation and aloneness.*
Middle age	*Generativity-self-absorption*	*If individual learns to relate to others outside himself, he is productive and happy; if not, if he becomes self-centered, he is less productive and more unhappy.*
Old age	*Integrity-despair*	*Integrity comes from being able to look back on life as a series of fulfillments; despair comes when reflection reveals only disappointments and failures.*

Source: Adapted from Erikson, 1963.

The Behavioristic Approach to Personality Development

Since the behavioristic approach views personality as largely the result of social learning, the idea of developmental stages is rejected. Development is assumed to be a more or less continuous process of learning and modifying particular behaviors in particular situations. Research conducted with children in which specific behaviors are acquired through reinforcement and observational learning suggest that basic learning principles, rather than psychosexual or psychosocial crises, may account for development quite adequately (Mischel, 1971). Consider the issue of moral judgments, for example. Bandura and McDonald (1963) have shown that children will

TABLE 16.6 *Stages of Moral Development and Their Characteristics*

Stage	*Characteristics*
Preconventional	
1.	*Punishment and power dominate, and determine obedience to rules; good and bad depend on the physical consequences of an action not upon any abstract conceptualizations.*
2.	*Rewards and positive need satisfaction dominate. Pragmatic approach to moral values, situations. People are valued because of their usefulness to others.*
Conventional	
3.	*Effect of actions on others, consequences for approval or disapproval dominate. Conformity is the rule. Intentions are considered important determiners of value.*
4.	*Authority, respect for order, and rules dominate. Order is rule in itself. Nonconformity leads to guilt, fear of censure.*
Postconventional	
5.	*Morality defined by social contract, entered into by whole society. Social utility is important agent in changing moral standards or law. Conformity in order to maintain welfare of the community.*
6.	*Morality defined by one's own principles, which are logical, comprehensive, universal, and consistent. Self-condemnation is main outcome of nonconformity. Universal human values dominate.*

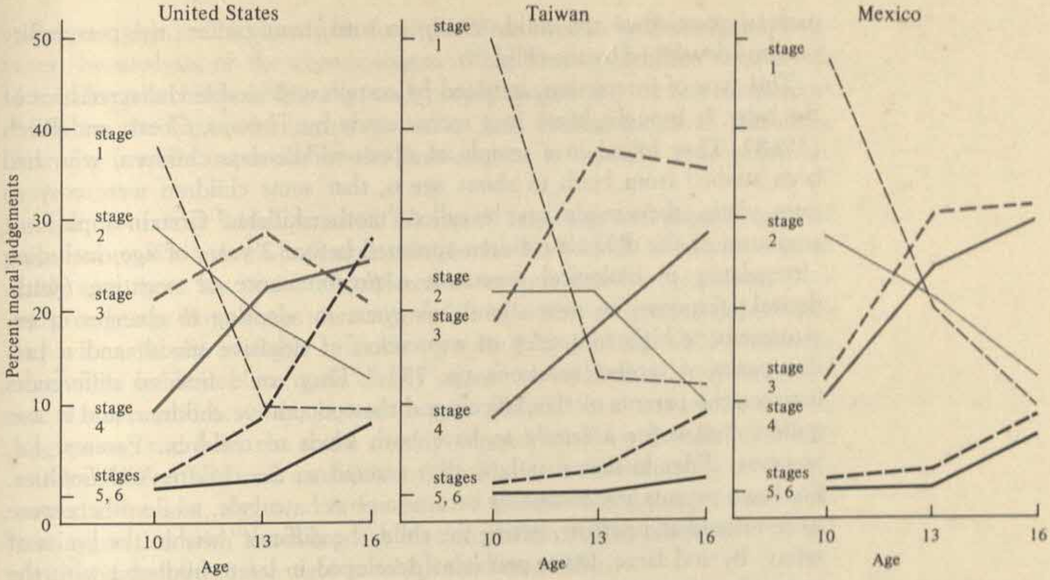
Source: From Kohlberg (1968) and Kohlberg and Kramer (1969).

modify their own moral judgments in the direction of judgments expressed by adult models. This finding would perhaps imply that the expression of different levels of moral judgment depends upon the opportunity to model those levels of judgment in adults.

Biology and Learning in Personality Development

A major question in understanding the development of personality concerns the relative importance of constitutional (i.e., biological) and environmental factors in determining the outcome. One extreme view, advocated by John B. Watson, is quoted below:

> Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief, and yes, even beggar-man and thief, regardless of his



Answers to questions of moral judgment given by children of different ages, from three different cultures (United States, Mexico, and Taiwan). The answers were scored according to the stages outlined in Table 16.6. Note that for all three cultures, the percentage of lower level answers declines with age, while higher level answers increase with age.
From Kohlberg & Kramer, 1969.

FIGURE 16.7

talents, penchants, tendencies, abilities, vocations, and race of his ancestors (1925, p. 82).

While such a view would hardly be advocated today, there is a strong environmentalist bias within American psychology, as has been pointed out before. In regard to personality development, there is a tendency to blame the shortcomings of an adult on the way his parents raised him, on the assumption that given "proper" rearing, everyone would be healthy and there would be few if any personality deviations. Thus, American psychologists might be said to be "mother-haters."

On the other side of the issue is the possibility that a given individual's biological endowment may in some significant way contribute toward his adult personality. One way to investigate this issue is to compare differences between identical twins as opposed to fraternal twins, as has been done in connection with intelligence and, as you will see, with psychopathology. The results are not very clear-cut. Identical twins do seem to be more similar in some respects than fraternal twins, but the pattern is not nearly so pronounced as it is in the case of intelligence or psychopathology. The most clear-cut results have been found with feeding and sleeping difficulties, in which identical twins are quite similar relative to fraternal twins (Brown, et al., 1967). Such difficulties, of course, might exert quite an effect on the

parents' reaction to the child, which, in turn, would affect the personality patterns developed by the child.

This type of interaction, initiated by certain undesirable characteristics of the baby, is brought home in a recent study by Thomas, Chess, and Birch (1968). They found in a sample of upper-middle-class children, who had been studied from birth to about age 6, that some children were easy to raise, while others might best be called "mother killers." Certain unpleasant attributes of the difficult children appeared before 2 years of age, including "irregularity in biological functions, a predominance of negative (withdrawal) responses to new stimuli, slowness in adapting to changes in environment, a high frequency of expression of negative mood, and a predominance of intense reactions (p. 75)." They could find no differences between the parents of the difficult and the cooperative children, and it was quite common for a family to have both kinds of children. Parents did, however, differ in terms of how they reacted to the children's difficulties. For some parents any encounter became a power struggle, while others were more relaxed and patient, letting the child "be difficult" within the limits of safety. By and large, fewer problems developed in later childhood with the more relaxed treatment.

The main point here is that even if one wishes to consider personality development solely in terms of "child-rearing practices," it is quite clear that the predispositions of both parents and child contribute to the nature of the interaction, which in turn may affect development.

Another phenomenon relevant to the general question of biological determinants of personality is that of sex differences. Boys are obviously different from girls in many ways, and the question has been raised concerning the importance of physiological differences between the sexes, as opposed to the strong cultural pressures to assume behaviors and roles appropriate to one's sex.

Various research studies have shown that boy and girl babies are different in many respects at birth or at very early ages. For example, newborn girls are affected more than boys by removal of the blanket covering them, and 2 to 3 months later are still more sensitive to stimulation of the skin (Bell & Costello; 1964; Wolff, 1965, cited by Mischel, 1971). Boys raise their heads higher than girls (Bell & Darling, 1965). In another study girls responded to faces with greater expressiveness and smiling, although boys continued looking at the faces longer (Lewis, 1969).

Young girls also show a greater verbal facility than boys. They talk earlier, are more fluent, and have higher verbal IQ's than boys, although boys tend to catch up by puberty. There is some indication that this finding is limited to white, middle-class children, which suggests that there is a strong cultural component, perhaps somehow connected with differences in behavior of the parents toward boy and girl babies.

Other experiments have investigated the sex-role behavior of children who are physiologically hermaphroditic (i.e., have both male and female sex glands but only one type of external genitalia). Such children are usually sex-typed on the basis of external genitalia and, indeed, the presence of the

other sex gland cannot easily be detected. True sex can be determined, however, by analysis of the chromosomes. What kind of sex-role behavior is found in such children? Usually, such people assume the sex role assigned at birth on the basis of external genitalia. This finding indicates that early learning is quite important in the development of sexually appropriate behaviors.

The two most widely studied sex-typed behaviors are dependency and aggression. While both boys and girls display both kinds of behavior at an early age, there are noticeable differences in their relative frequency. At a very early age boys show more aggressive behavior, girls more dependency behavior, and the available research (reviewed by Mischel, 1971) indicates that these behaviors are quite clearly related to child-rearing practices and social expectations. Girls, however, very quickly learn not to be overtly aggressive, and boys not to be overtly dependent. Even though individual children differ from one another considerably in their conformity to the expected behaviors, the trend is for boys to become less dependent and girls less aggressive with increasing age, so that these two behaviors have turned out to be the two major ways in which the sexes differ.

Summary

The study of personality focuses upon the uniquenesses of individuals, and attempts to understand their causes and their consequences. Several different approaches to personality have been taken in recent years. They are (1) the trait approach, in which people are described in terms of relatively enduring characteristics or dispositions to behave in particular ways; (2) the psychodynamic approach, focusing upon the role that motives and conflicts between motives, particularly at the unconscious level, play in behavior; (3) the behavioristic approach, emphasizing that different people learn different behaviors, and focusing on the stimulus conditions under which the behaviors occur; and (4) the phenomenological/cognitive view, which emphasizes how people perceive or think about themselves and others. Significant problems within the study of personality with which these approaches must deal include assessment, or the measurement of personality characteristics; development, which deals with the question of how adult personalities come to be; and deviation, which is concerned with socially relevant behaviors that deviate from the normal.

The assessment of traits is accomplished by a number of tests, including the 16 PF, the California Psychology Inventory, the Maudsley Personality Inventory, and a number of tests designed to measure individual traits such as dogmatism and authoritarianism. Psychodynamic assessment is usually by means of the clinical interview or projective tests, including the Rorschach and the TAT. Behavioristic assessment requires the observation of behavior in specific situations and does not attempt to specify underlying traits or

motives. Phenomenological assessment uses such devices and the *Q*-sort and the REP test to determine how individuals think and feel about themselves and other people.

There are several different approaches to development. One prominent approach is that development proceeds in stages; several theorists, including Freud, Kohlberg, and Erikson, have postulated various stages of personality development. Another issue concerns the relative contribution of constitutional and learned factors to personality development. Current research suggests that both sets of factors contribute significantly to development of personality characteristics.

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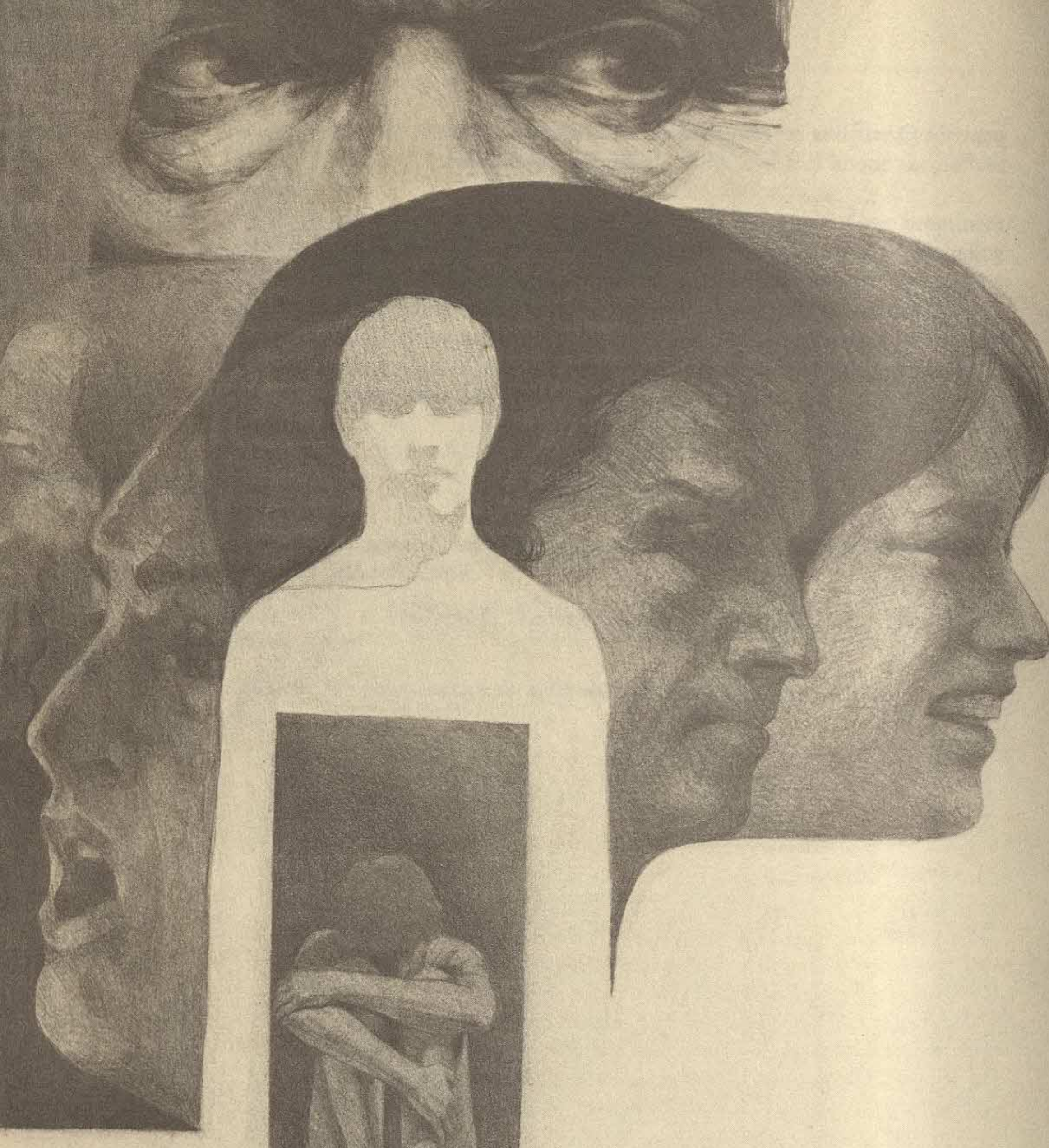

Personality Deviation

17

Regardless of how one conceptualizes the fact of individual differences, Chapters 15 and 16 should have made it clear that behavior is quite variable across individuals. Much of the variability is considered to fall within the normal range. However, some patterns of behavior are either so deviant or potentially harmful that they are of concern to society. When such patterns occur, the terms personality disturbance, psychopathology, abnormal behavior, and mental illness are often applied.

Psychiatric patients, most of them in public institutions, account for a large proportion of all those hospitalized in this country. And another group of patients, at least as large as the 350,000 or so hospitalized, are receiving outpatient care. The total bill for mental illness is more than $4 billion per year and rising (Phillips, 1968). Furthermore, several surveys have been taken of the presence of symptoms of personality disturbances in the population at large, and one estimate (Ullman & Krasner, 1969) suggests that perhaps one out of every four people is abnormal in some respect.

Psychopathology is not a new problem. It has been of concern throughout history, and afflicted individuals have been subjected to the most astonishing variety of "treatments," depending on the prevailing theory of the cause of the disturbance. Hippocrates, the great physician, thought that such people were diseased, and devised various treatments for altering the body humors. The "evil spirit" view predominated through the Middle Ages into modern times, and one treatment was to allow one's evil spirits to leave the body through holes in the skull cut by concerned physicians. As for treatment, the mentally ill have, for the largest part of recorded history, been chained in asylums and otherwise treated most inhumanely. A change in approach was advocated by Phillipe Pinel (1745–1826), who saw mental illness as a moral disorder and proposed wholesome, humane, and pleasant treatment of patients. The conditions in mental hospitals improved until the "medical view" of Hippocrates became fashionable. Conceiving mental illness to be a disease like tuberculosis or influenza gained favor when it was discovered

that general paresis was caused by syphilis. (Paresis involves both physiological and psychological symptoms, including paranoia and disordered thinking.) The rise in popularity of the medical view led once again to a deterioration in the conditions of hospitalization for patients, since the benevolence advocated by Pinel was no longer considered medically necessary.

Even now, there are several different ways of looking at deviant behavior, and these ways are at least somewhat related to the general theoretical approaches to personality that you encountered in the last chapter. Associated with the trait approach, there is the *statistical* or *normative view* of deviation, which relates extremes in behavior to extreme levels of certain personality traits such as those described earlier. Extraordinarily dominant, submissive, introverted, shy, or intelligent persons, for example, would be considered deviant. An implication of this view is that abnormal behavior is seen as being on the same continuum as normal behavior, i.e., not different *in kind* from normal behavior. In contrast, the *medical* or *disease* view places abnormal behavior in a wholly different class from normal behavior. Mental illness and the resulting behavior are seen as being due to some "disease process," which may be interpreted in psychodynamic terms as underlying conflicts, or may have other interpretations, such as a physiological or biochemical abnormality. The *behavioristic* approach emphasizes that deviant behavior consists of specific responses that were learned under specific conditions, and which are under the control of certain discriminative stimuli and reinforcement contingencies. One version of the *phenomenological* approach (Rogers) emphasizes that the deviant person has difficulty in integrating his self-concept with his experience and must deny or defend against experiences that are incongruent with his self-concept. No disease process is inferred. The patient's problems are not so much the result of underlying unconscious conflicts as they are caused by the failure to integrate significant aspects of his personality as he experiences himself.

All of these approaches must deal with the fact that different behaviors are considered deviant by different societies. For example, in Western civilization reports of hallucinations are usually taken as indicative of a mental disorder. However, in other societies such as the Plains Indians or certain Eastern religious groups, hallucinations are quite acceptable. Although extreme suspiciousness of other people is viewed as deviant in our own society, suspicion is the rule for the natives of Dobu (Suinn, 1970). Thus deviance is in part a social and socially defined phenomenon, one element of which is the fact that the behaviors are negatively valued by the society labeling them as deviant. It is also a legal phenomenon, since persistence in deviance may result in such legal action as being declared insane and committed. On the other hand, in the discussion that follows you will see that there is some evidence that some forms of mental illness are the result of (possibly hereditary) physiological processes operating in particular environments. The role that culture plays in defining and producing deviance, and how this factor interacts with physiological abnormalities remains to be seen.

We now turn to a description of some of the types of psychopathology identified as such in Western civilization. You will learn the labels for some

of the forms of deviance. However, you should be aware that there is some objection to this kind of labeling among psychologists, and you will learn some of the reasons for these objections presently. Along with a description of the symptoms of the various disorders, some of the ideas and evidence regarding their causes will be discussed. Our discussion will focus on four categories of psychopathology: neuroses, psychoses, conduct disorders, and psychophysiological disorders.

Neuroses

The neurotic person has learned to deal with threats and anxiety, but in ways that interfere somewhat with his normal functioning in society. The situation is rarely so severe that hospitalization is required, and his orientation to reality is usually sufficiently intact that he can function moderately well. His manner of dealing with anxiety is presumably reflected in the different subcategories of neurosis outlined in the following section. Thus he simply experiences anxiety (anxiety reaction) or may *displace* it to some other object (phobias, hypochondriasis). He may protect himself against it by *doing something* (obsessive-compulsive reaction) or *denying* certain aspects of his experience, i.e., not doing something (conversion reaction, dissociative reaction). In addition, he may become *depressed* as a result of certain life experiences (neurotic depression).

Although the characteristics associated with these categories of neurosis will be described, you should bear in mind that assigning a person to one or the other category cannot be done very reliably. (This point was discussed in the previous chapter.) The behavior exhibited by a real person does not always fit neatly into the abstract categories used by professionals, and when categorization requires the professional to make inferences about underlying personality dynamics (e.g., how anxiety is handled) the problem is compounded.

ANXIETY REACTION

The main symptom of anxiety reaction is the experience of "free-floating anxiety." The individual feels jumpy, afraid, and may exhibit various symptoms of increased sympathetic activity such as pounding of the heart. No target of the fear is present, however, and the symptoms occur in many different situations. As the case described on p. 510 indicates, the symptoms *can* be quite debilitating and disruptive of a normal life.

PHOBIC REACTION

In a phobia anxiety is "attached" to something specific, in contrast with the generalized fear in the anxiety reaction. Of course, everyone occasionally encounters circumstances in which fear is quite justified, and this kind of fear is not considered pathological. When, however, the fear is both irrational and interferes with the person's daily affairs, it is considered to be abnormal. Snakes, spiders, heights, open places, going to work, taking examinations, and closets, are only a few common objects of phobias. As in the case of anxiety reactions, phobic reactions can interfere quite severely

Anxiety Reaction

Mary G. was 28 years old when she sought help from the outpatient clinic of a large hospital. She had experienced various physical difficulties at times for several years before seeking treatment. For instance, shortly after eloping to a large city, she experienced tingling in her leg, numb extremities, and chest pain. About 6 months before she came to the clinic, she again experienced the tingling and numbness, together with extreme nervousness, fear of death, dizziness, weakness, and trembling. Her appetite declined, and she lost much weight. She became quite conscious of her heartbeat, which she feared was too slow. Her family doctor referred her to the psychiatric clinic, but after one visit she refused to return, since she was certain that her symptoms were physical in nature (Adapted with permission of Macmillan Publishing Co., Inc. from Patterns of Psychology, *by M. Zax and G. Stricker © 1963 by Macmillan Publishing Co., Inc., pp. 139–140).*

with one's daily life. Just consider how it would be if you were deathly afraid of taking examinations or of walking out in the open to get from one building to another on campus.

HYPOCHONDRIASIS

In hypochondriasis anxiety presumably becomes "attached" to one's body functions, the hypochondriac is excessively concerned with his health to the exclusion of practically all other interests, as well as the boredom of whatever friends he may have. He is the natural prey of patent medicine and health food vendors, and often is quite knowledgeable about his latest "disease."

In some sense the hypochondriac is like the hysteric, in that the focus of his symptomatology is his own body. However, unlike the hysteric, the hypochondriac may be overtly anxious, in addition to his other symptoms. As illustrated in the case history, effecting a cure may be difficult because of the unwillingness of the patient to recognize or admit that his symptoms are of psychological origin.

OBSESSIVE-COMPULSIVE REACTION

In obsessive-compulsive disorders, anxiety is presumed to be expressed in the form of unwelcome and persistent thoughts (obsessions), or strong impulses to perform some activity, such as washing the hands (compulsion). One may be overconcerned with small, unimportant details or respond in unusual ways to particular stimuli, as is the case with the patient described below. Lady Macbeth is a classic example of this disorder, which is dramatized so well in the handwashing scene following Duncan's murder.

Martha S., who was 26 years old when she sought psychiatric help, was extremely afraid of cats and other small furry animals. She had had this fear as long as she could remember. The earliest encounter with such objects that she could recall was when she stroked a kitten that was sitting on her father's lap. She was 3 or 4 years old at the time, and was quite disturbed by the feeling of fur and bones. Her phobia was quite inconvenient, since she felt she had to go out of her way to avoid such animals. Whenever she went out of doors she felt she had to have someone else with her to protect her from a possible encounter with cats.

Although married to a junior executive and the mother of two children, she and her family lived with her parents. She attributed her rather poor sexual relationship with her husband to this fact. The psychiatrist who interviewed her felt that her basic problem was due to deep-rooted incestuous feelings toward her father, and recommended psychoanalysis (Adapted with permission of Macmillan Publishing Co., Inc. from Patterns of Psychopathology, *by M. Zax & G. Stricker © 1963 by Macmillan Publishing Co., Inc., pp. 147–148).*

CONVERSION REACTION (HYSTERIA)

In hysteria the symptoms involve some part of the body that seems not to function properly; yet no physical disease process can be found. The term *conversion reaction* comes from Freud's theory that in this disorder, anxiety is "converted" into a physical symptom. (See p. 514.) Blindness, deafness, immobility of a limb, areas of anaesthesia on the body surface, and sexual difficulties have been experienced by hysterical patients. The hysteric, of all the neurotics, is the one who is least troubled by overt anxiety. Nor is there usually very much concern over the physical symptom. Brady and Link (1961) describe a patient who became blind while he was Christmas shopping with his wife and her mother. As it turned out, the blindness was of psychogenic origin and served to gain him a military disability pension as well as to remove pressure from his wife and mother-in-law. He recovered following a behavior modification procedure in which he was reinforced for using visual cues.

In many cases some such "secondary gain" can be found as a result of the symptoms, although, from the patient's point of view, they are nonetheless real. Exactly how someone can make himself insensitive or immobile in this way remains to be determined.

Hypochondriasis

Jeff is a drugstore clerk who is fond of taking drugs. He is the first to try each new pill as it comes on the market, on the excuse that they will help some one of his conditions. His main topic of conversation is his health, and he frequents various physicians, including some known quacks.

His social life is limited to the few people who can tolerate his concern with his health, although some find him amusing. He never married because he felt his poor health would make it hard for him to support a family. He could not progress in school work beyond the eighth grade because whenever be studied, he had pains in his chest and feelings of pressure in his head.

Although encouraged to see a psychiatrist, he feels that such an action would not be appropriate, since he thinks he does not have any emotional problems. He feels that all of his problems have an organic base, and that physicians can not diagnose them adequately because of their backwardness or perhaps because his disease is so rare that modern medicine has not yet discovered it. (Paraphrased from Suinn, R. M., Fundamentals of Behavior Pathology. *New York: Wiley and Sons, 1970, 1st Edition, p. 233).*

DISSOCIATIVE REACTIONS

This class of disorders includes such diverse phenomena as somnambulism (sleep-walking), amnesias, fugue states (in which the person suddenly disappears and is later found leading a life somewhere else, perhaps with no recollection of his past existence), and multiple personality (as in the case of Dr. Jekyll and Mr. Hyde. Another example is the well-known case of "The Three Faces of Eve," in which the patient manifested three different personality patterns, moving from one to another somewhat unpredictably.) Except perhaps for sleepwalking, this type of reaction is not too common.

DEPRESSIVE REACTION

Depression usually occurs when someone has experienced a major loss, such as that of a loved one, and is a natural reaction to the situation. However, sometimes the reaction may be out of proportion to the circumstances and may persist long beyond the time when most people would have resumed normal activities. The person may remain despondent, inactive, unable to work or to concentrate, and exhibit no hope for the future. As happened in the case described on p. 515, recovery often eventually occurs without explicit treatment.

CAUSES OF NEUROTIC BEHAVIOR

There are several different schools of thought about the causes of neurotic behavior, although almost everyone believes that neurosis is the result of learning. Several theories of personality (Chapter 16) were actually attempts to explain deviant behavior and relate it to normal behavior. The psychodynamic approach, as you can anticipate, emphasizes the importance of

Obsessive-Compulsive Reaction

Marcia C. was admitted to a hospital 2 years after she began to exhibit obsessional and compulsive symptoms. It started when she became extremely anxious that she had not made the dessert for a Christmas meal correctly and that those eating it might be harmed. Soon she was unable to cook or even to give vitamins to her children for fear of poisoning them. She would not drive because she was afraid she might kill somebody. She spent her time checking all possible sources of danger in the house including tools, locks, the fireplace, etc. She bathed as often as six times a day, for fear that she would carry germs into the house.

A physician prescribed tranquilizers, which gave her partial, but not complete, relief. Then, when her husband developed a stomach ulcer, her symptoms grew worse and she went into the hospital. She was discharged with tranquilizers because she was considered to be a poor candidate for psychotherapy, her main interest being in physical care rather than in attempting to understand her problem (adapted with permission of Macmillan Publishing Co., Inc. from Patterns of Psychothology, *by M. Zax & G. Stricker © 1963 by Macmillan Publishing Co. Inc., pp. 170–172).*

conflicts originating in early childhood. These conflicts, although rarely recognized as such by the patient (because of the operation of repression), are thought to operate unconsciously throughout life unless exposed by psychoanalytic therapeutic procedures. Neurotic behavior, then, is the result of events in one's inner "mental life" that are largely inaccessible to awareness. Freud analyzed several cases of hysteria and concluded that the afflicted part of the body is somehow associated with guilt feelings because of some experience involving that part of the body. He thought the object of a phobia symbolized some object of fear that one had experienced previously, usually in association with sexual or aggressive motivation. He thought obsessions and compulsions originated in early life, during cleanliness and toilet training. In general, Freud's idea is that the behavior in question serves the function of reducing anxiety by preventing the person from facing in a realistic way his unacceptable feelings and past experiences.

The behavioristic approach is that neurotic behaviors are to be explained by the individual's past history with reinforcement contingencies and imitation. Conflicts and other inner states, conscious or unconscious, are more or less ignored. A phobia, for example, would be considered as a fear reaction acquired on the basis of classical conditioning. The object of the phobia may

Conversion Reaction

Curt Z. suffered from several physical symptoms which after 2 months led him to seek psychiatric help. He had daily attacks of a set of symptoms that included loss of voice, a feeling of choking in the throat, a tight neck, jerking motions of the head, hives (welts on his arms and face), sweating, and nausea. His work in the family butcher shop, which was run by his father, was seriously limited. For the several weeks before he sought help he was unable to leave his room without having the symptoms return.

His relationship with his father, with whom he felt he had to work, was less than ideal; the father was clearly dominant and would often embarrass Curt with his outbursts of criticism. This behavior occurred even though Curt was 35 years old and the father of three children.

Curt was accepted for psychotherapeutic treatment, but after the initial interview he took a vacation and never returned to begin treatment (adapted with permission of Macmillan Publishing Co., Inc., from Patterns of Psychopathology, *by M. Zax & G. Stricker © 1963 by Macmillan Publishing Co., Inc., pp. 162–164).*

be the actual conditioned stimulus or may be effective because of generalization from the original CS. Compulsive behavior is presumed to exist because it is maintained by certain reinforcement contingencies that would be different in each case. As you will see in the next chapter, the form of treatment advocated by behavioristic clinicians involves focusing upon the specific behaviors in question, rather than attempting to "uncover" hidden conflicts.

The phenomenological view of neurosis focuses upon the present and tends to ignore past events, whether they be reinforcement contingencies, patterns of imitation, or conflicts resulting from childhood experiences. Neurotic behavior is the outcome of the individual's failing to assume responsibility for his own behavior, and successful treatment requires him to assume this responsibility. As indicated above, the discrepancy between one's ideal and his real self may present a problem, and the individual must somehow integrate the two. Again, however, the main issue is one of responsibility: The healthy individual assumes responsibility for what he does, while the neurotic cannot.

Psychosis

Psychosis is the most severe of the behavior disorders and makes the greatest demand on inpatient psychiatric care. Furthermore it is the most severe disorder in terms of disruption of personal affairs. On the other hand, various somatic therapies, including tranquilizing drugs and shock therapy (see

Neurotic Depressive Reaction

John O., 45 years old, was partially paralyzed as a result of a heart attack and was unable to return to his job as butcher. While undergoing rehabilitation treatment, he became despondent over his disability, and stopped treatment. He thought he would never be able to use his right hand and arm again, and, since his life's work was involved, he felt hopeless. His condition was such that he refused to get out of bed or talk with anyone.

He was moved to another room; his new roommate was older but with the same disability. He was cheerful, however, and had made progress in rehabilitation. John was at first hostile and resentful but then became interested in his roommate's progress. He returned to physical therapy and began making plans to return to work in a capacity that was consistent with his paralysis (paraphrased from Suinn, R. M., Fundamentals of Behavior Pathology. *New York: Wiley and Sons, 1970, 1st Edition, p. 247).*

Chapter 18) have made it possible for many psychotics to be treated on an outpatient basis. The former snake pits of many mental hospitals have become rather benign, quiet places. The bizarre behavior described in popular accounts of mental hospitals and "crazy people" is much less in evidence than previously, and is probably more likely to be found outside than inside a hospital.

While there are several different varieties of psychosis, all of them involve some loss of contact with reality. A person who is actively psychotic may experience perceptual distortions (hallucinations), cognitive distortions (delusions and disorganized thinking), and perhaps motor abnormalities. Of the various types of psychosis, we shall consider the two major categories: manic-depressive psychosis, characterized by extremes in mood or affect; and the schizophrenias.

MANIC-DEPRESSIVE PSYCHOSIS

The chances for complete recovery from a manic-depressive psychosis are quite good—much better than in the case of schizophrenia. Nevertheless, the symptoms during the course of the illness may be quite debilitating, and physical harm to the victim or to other people is a real possibility. Many suicides are carried out during psychotic depression.

The two poles of this disorder are mania and depression. Sometimes both types of behavior are seen in the same individual with some cyclic variation between the two; sometimes the psychosis is almost entirely or exclusively manic or depressive.

Symptoms of the manic state are excitement, supreme confidence, grandiose ideas that shift too readily for any one of them to be focused upon,

and an inexhaustible supply of energy. In his excitement the manic may enter into large, unrealistic business deals; become involved with several members of the opposite sex at the same time, even to the extent of several marriages; and, in general, get himself into trouble through his excessive and unrealistic activity. Violence is sometimes seen, and in extreme cases verbalizations may border on the incoherent.

In depression, on the other hand, the person is abjectly despondent, listless, and feels that his life is worthless. He may have delusions of his own supreme guiltiness to the point of hearing voices accusing him of various misdeeds. A severely depressed person may have suicidal thoughts, and in many cases suicidal attempts are made.

While the two types of symptoms appear to be opposite in character, the fact that they occur together so often has led to their classification together. Indeed, many investigators think that both sets of symptoms have depression as their underlying basis, with mania being simply a severe reaction against the basic depression (London, 1968).

Schizophrenia

Schizophrenia is the most serious of the psychotic disturbances, both from the point of view of the effect on the individual and his associates, and also in terms of the long-term chances for cure. Actually, however, there may be several different disorders carrying the schizophrenia label, and the outlook for some of them is better than for others. For all of the categories there is at least one of the following symptoms: a tendency to withdraw from the "real" world; a certain amount of inappropriate emotional expression; somewhat bizarre patterns of thought and speech; peculiarities of posture and movement; and sensory and cognitive distortions, including hallucinations and delusions. There are also differences in the various categories of schizophrenia, which will be described briefly below. The major categories to be discussed are simple, catatonic, paranoid, and hebephrenic schizophrenia.

SIMPLE SCHIZOPHRENIA

Simple schizophrenia develops gradually over a number of years, and the symptoms are so undramatic that the individual usually attracts little attention to himself. The main symptoms, at least overtly, are apathy and withdrawal from social contacts. The simple schizophrenic may be accused of being lazy, shiftless, etc., because of inattention to the responsibilities of a job. He may appear eccentric, shy, and insensitive to social demands. Delusions, hallucinations, and bizarre forms of behavior are absent. It is thought that many individuals existing on the edges of society, such as tramps and drifters, may in fact be simple schizophrenics.

CATATONIC SCHIZOPHRENIA

More dramatically, the catatonic schizophrenic exhibits either profound stupor or excitement. In the stuporous phase, he may be quite immobile, holding positions into which he is placed for long periods of time ("waxy flexibility") and being quite unresponsive to external stimuli. Those who do respond may simply repeat what they hear ("echolalia"). Negativism may also appear in this phase, in which the patient does the opposite of what he

Manic-Depressive Psychosis

Lillian H. entered a mental hospital for the third time when she was 62 years old. A spinster, she had a responsible office position with a large business. Her mother had died 31 years previously, and shortly thereafter Lillian began to experience a cyclical pattern of depression and hyperactivity. She would occasionally become involved in expensive, impractical schemes that were financially disastrous. After one of these she entered her first period of hospitalization, which lasted for 6 months. Her most recent admission came about when she became severely depressed, apparently related to feelings that she could not work as efficiently as she had once worked. These feelings led to her retirement and gradual deterioration. She ate very little, cried a lot, and roamed aimlessly about the house saying "What shall I do? It's too involved."

In the hospital she was treated with electric shocks. By the end of two months her depression had lifted. She was discharged and was well for at least the next 5 years (adapted with permission of Macmillan Publishing Co., Inc., from Patterns of Psychopathology, *by M. Zax & G. Stricker © 1963 by Macmillan Publishing Co., Inc., pp. 27–29).*

is told to do, and resist attempts to move his limbs. In the excited phase, there may be a considerable amount of agitation, with destructive outbursts of an intense sort. Hallucinations and delusions may be present in the catatonic schizophrenic.

Some psychologists feel that this kind of disorder is decreasing in frequency of occurrence, and it has been suggested (e.g. London, 1968) that it is actually a reaction to the conditions of hospitalization, rather than a primary type of disorder. Whether or not this is true remains to be seen.

PARANOID SCHIZOPHRENIA

Paranoid schizophrenia occurs more often than the other types and also seems to require a certain level of intelligence. At least it appears that paranoid schizophrenics are brighter than other schizophrenics. This disorder is distinguished by a delusional system in which the indivdual may feel that he is a very important person (delusions of grandeur) and, for this reason, is the object of a concerted plot to "get" him (delusions of persecution). Quite often the paranoid may have the idea that people are trying to "influence" him through unusual means, such as "radio waves," or other forms of thought control. The influence may take the form of hallucinatory voices that prod or accuse him in various ways.

HEBEPHRENIC SCHIZOPHRENIA

The most disorganized of all the schizophrenics is the hebephrenic and, in many respects, the verbalizations and thought patterns are the most bizarre.

Catatonic Schizophrenia

Mildred D. had suffered a number of losses prior to her hospitalization at age 58, including a divorce, estrangement from two children and the loss of three others, a breakup with a serious "boyfriend," and her son's imprisonment for robbery. She reported seeing faces in the window of her car, fearing someone was hiding in it. She then began to do only those things that she felt God wanted her to do, and gave other indications of excessive religiosity. Her work deteriorated, and she was laid off 2 weeks before her admission to the hospital, after which she refused to leave her apartment.

While in the hospital she often stared into space and was quiet, keeping to herself. Her hallucinations mainly involved God and one of her dead daughters, whom she had been particularly fond of. She improved gradually with drug therapy, but her hallucinations returned after a year. She was then given electric shock treatment. She improved considerably and was discharged (adapted with permission of Macmillan Publishing Co., Inc., from Patterns of Psychopathology, *by M. Zax & G. Stricker, © 1963 by Macmillan Publishing Co., Inc., pp. 74–76).*

Inappropriate giggles, strange gestures, and unusual facial expressions are often seen, together with rather unorganized and incoherent hallucinations and delusions. Sometimes the delusions involve parts of the body, for example, that one is hollow inside, or that one's brain has been removed. This category of schizophrenia is quite rare now and, like catatonic schizophrenia, is thought by some to be a result of the conditions of hospitalization rather than a primary disease category.

THE CONSEQUENCES OF SCHIZOPHRENIA

There is some debate as to whether schizophrenia is ever actually "cured." Many schizophrenics return to a relatively normal life after varying periods of time but may show residual symptoms of the more severe form of the illness. Tranquilizing drugs such as chloropromazine have done much toward reducing the census of mental hospitals and returning schizophrenics to a more normal existence as well as shortening the period of confinement necessary for treatment. These pharmacological developments, coupled with an increased acceptance by the public of people with a history of mental illness creates a potentially much brighter picture for one with a schizophrenic disorder than existed previously.

This hopeful prognosis is more likely to be realized in the case of individuals whose symptoms have a relatively sudden onset, as though they were a reaction to some new stress in their environment. Thus, for *reactive* schizophrenia the onset is sudden and the course of the disease is more rapid than in the case of *process* schizophrenia. In the latter case the onset of symptoms is more slow, and the likelihood of significant improvement is

Paranoid Schizophrenia

Roscoe W. was 48 when he was admitted to the hospital for the first time. For several years, shortly after a friend had been shot under mysterious circumstances, he became quite suspicious of people. He felt that people were telling children that he was an evil person, and he would attempt to avoid them. Shortly before being hospitalized, he complained that some acquaintances were plotting to break into his house and rob him, and that he thought his house had been wired for sound. Then he began to refuse food and said he heard voices of old army acquaintances from the cellar of the house.

During his hospitalization his memory, fund of information, and powers of concentration seemed quite adequate, although he was evasive in his answers to questions and reported many strange thoughts and ideas, including hallucinations. After 3 months, however, he showed great improvement and was discharged for treatment in the outpatient clinic (adapted with permission of Macmillan Publishing Co., from Patterns of Psychopathology, *by M. Zax & G. Stricker, © 1963 by Macmillan Publishing Co., Inc., pp. 84–86).*

considerably less. In general, it can be said that the better one's adjustment before the onset of symptoms, the more likely he is to recover.

CAUSES OF PSYCHOSIS

There are a number of different points of view about the cause of manic-depressive and schizophrenic disorders. For some time there has been an indication that hereditary factors play an important role in both types of psychoses. In schizophrenia, for example, it has been found that if one member of an identical twin pair is schizophrenic, then the chances of the other twin's being schizophrenic are quite high. In one study (Kallman, 1953) the chances were 86 in 100. For fraternal twins, on the other hand, the chances of a second twin's being schizophrenic are much lower, around 15 in 100. This kind of evidence, while not conclusive, is quite suggestive of a genetic predisposition for the disease. Similar findings have been reported for manic-depressive psychosis.

Another line of research has attempted to find biochemical factors related to schizophrenia. In general the approach has been to try to isolate chemicals from the blood or urine of schizophrenics which, when injected into normal individuals, will produce some of the psychotic symptoms. The discovery of the hallucinogenic properties of LSD in 1946, of course, gave quite a boost to this line of research, since LSD is quite closely related to a neural transmitter substance, serotonin.

One chemical that was discovered was *taraxein.* According to some reports taraxein can, when administered to normal persons, produce some of the

symptoms of schizophrenia, including feelings of depersonalization, delusions, hallucinations, and some bizarre behavior (Heath et al., 1966). This work has been difficult to replicate, however, and so any firm conclusions must be postponed. Another chemical, equally controversial, that has been implicated is *adrenochrome*, which is a by-product of the metabolism of epinephrine. According to Hoffer and Osmand (1959) adrenochrome can produce psychoticlike symptoms in normal individuals.

Some forms of depressive illness have been linked to a deficiency in the metabolism of norepinephrine, one of the excitatory transmitters (see Chapter 4). There is an enzyme called monoamine oxidase (MAO) which breaks down norepinephrine, i.e., renders it inactive. It has been found that if an inhibitor of MAO is given to the patient, his mood is elevated and many of the depressive symptoms disappear. Thus it has been suggested that the depressive person may have a deficiency in norepinephrine, or perhaps an excess of MAO.

These biochemical findings are provocative if not conclusive. It would constitute a major breakthrough if a chemical were found that could be demonstrated to cause the symptoms of psychosis. However, there are other interpretations of the evidence as it exists today. Perhaps a major question has to do with whether the chemical differences between normal persons and psychotics are the cause or the result of the psychosis. It is reasonable to assume that there might be chemical changes in the bloodstream resulting from the stresses that a psychotic is likely to undergo, not to mention the differences in diet that might exist between hospitalized psychotic individuals (who may not eat very well, even if an adequate diet is available) and normal patients. Given the rather convincing evidence of the hereditary aspects of these psychotic disorders, it appears that some chemical or other physiological explanation is not at all unreasonable.

Other investigators have attempted to uncover patterns of behavior within families of schizophrenics that might account for the disorder. For example, it has been proposed that when there is pronounced psychopathology in one parent which is supported by the other parent, the child is more likely to be schizophrenic (Lidz, Alanen, & Cornelison, 1963). Other situations, in which the parents dislike and/or mistrust each other have been implicated as well. Another pattern of parent-child relationships is called the "double bind" (Bateson et al., 1956). The idea is that a parent communicates messages to the child which conflict with one another so that the reception of one message contradicts what is implied by the other. Moreover, the child is forced to hear both messages. As Suinn (1970) puts it, "It is like a bizarre game in which everyone agrees to behave incomprehensively but acts as if everything were entirely comprehensible (p. 394)." For example, a child may cling to his mother who, out of irritation, says "Don't do that—you know mother loves you," thereby expressing love and rejecting him at the same time. Bateson et al. assume that this kind of incongruity sets the stage for the child's learning that communications do not mean what they seem, and, indeed, that their meanings may be quite obscure. Thus the basis for establishing a warm and rewarding relationship

with other people may be suppressed as well as the idea that it is possible for people to communicate meaningfully with one another.

It has been suggested that individuals suffering from manic-depressive psychosis have experienced a relative lack of positive reinforcement in their lives. They are often, it is said, the products of homes in which high expectations were coupled with very little praise for their accomplishments.

As you might expect, there obviously are homes in which the above "difficulties" are present but still do not produce psychotic children. If such environments do in fact contribute to the development of psychosis, then the question remains as to why some people and not others who are so exposed develop the disorders.

Conduct Disorders

There are a number of patterns of deviant behavior that do not seem to be characterized by irrationality, bizarreness, or excessive anxiety, but which, on the other hand, are in clear violation of the accepted moral codes of society. The labels for these behavioral patterns include *psychopathic personality,* various *addictions,* and *sexual deviations.* Sometimes these behaviors are labeled *sociopathic,* in that they seem to be turned against society or to ignore its prescriptions.

PSYCHOPATHIC PERSONALITY

The psychopathic personality is one who appears quite well-integrated and socially competent but who performs socially unacceptable acts, such as lying, stealing, being undependable, etc., apparently with no feeling of remorse. These people often excel in social competence, as the case history illustrates, and for this reason are often able to get away with their behaviors. Many, however, are caught by the law and wind up in prison.

DRUG ADDICTION

There are a number of drugs on which one can become dependent, and some of these produce the physiological dependence called addiction. By and large, the most popular addictive drug is alcohol. The economic implications of this disease are tremendous, as are the psychological and sociological impact of alcoholism on the individual and on society.

Although the personality factors leading to alcoholism are not well understood, there is some agreement that the alcoholic begins to drink in order to relieve tension and avoid conflicts. However, most of the research that has been done is limited to people who are already chronic alcoholics (Suinn, 1970), and it is possible that excessive use of the drug itself would produce some of these symptoms. Cultural differences in the incidence of alcoholism (a high rate among the Irish and French, and a low rate among Jews, Italians, and Chinese) indicates that implicit norms for handling alcohol may be of some importance.

Other addictive drugs include opium and its derivatives morphine, heroin, and codeine; barbiturates such as phenobarbital; and amphetamines. As is the case with alcohol, withdrawal of the drug after addiction results in severe physiological symptoms.

Antisocial Reaction

John was a very bright man who was able to earn a bachelor's and a master's degree in economics. He was able to accomplish these ends because of his intelligence and because he was shrewd enough to impress his professors without doing much work, except that which he was able to convince his girl friends to do. After graduating he worked at various jobs, including a road gang in Alaska, a seaman, and a part-time lecturer in a small college. He also spent a year as a "hippie."

He obtained a job as a research economist in city planning, at which he routinely missed deadlines and prepared verbally profound reports devoid of data. He was not rehired when contract renewal time came around.

He had a history of writing bad checks. He was dismissed from one institution for forging the dean's name on a check. Other "flim flams" were not prosecuted because his victims were invariably charmed by him and thought they might contribute toward his rehabilitation. After leaving his last job he went on vacation, financing it with a bad check (paraphrased from Suinn, R. M., Fundamentals of Behavior Pathology. *New York. Wiley and Sons, 1970, 1st Edition, p. 278).*

There seems to be no pattern of psychopathology characteristic of the drug addict, and most addicts do not exhibit symptoms of other personality deviations (Suinn, 1970).

Other drugs may produce so-called psychological dependence, which means that the individual has a strong desire to use them, but without necessarily being physiologically addicted. Such drugs are marijuana, cocaine, and hallucinogenics such as LSD and mescaline. Although some of the individuals using them may be antisocial, these drugs are used by such a wide variety of people that it is impossible as yet to outline any particular personality characteristics associated with their use.

SEXUAL DEVIATIONS

Just as for other behaviors, there are social norms and moral values specifying how one may and may not gratify his sexual desires, and some individuals substitute sex objects or practices that deviate from these norms. Other individuals have too much or too little sexual desire, and are also considered deviant. Naturally, the most appropriate object choice for sexual gratification is a member of the opposite sex who is sexually mature. Any other choice, including members of the same sex of any age, children, animals, corpses, and such inanimate objects as female underclothes or shoes is considered a deviant "conduct disorder." Acceptable behaviors are also limited and exclude such practices as anal or oral intercourse, sadism (punishing one's partner), masochism (punishing oneself), or substituting some nongenital act such as exhibiting oneself or watching others. Variations in the amount of sexual desire include nymphomania (too much desire in a female),

satyriasis (too much desire in a male), frigidity (too little desire in the female) and impotence (too little desire, and inability to achieve an erection in the male).

Probably the most prevalent sexual deviation is homosexuality, in which one prefers members of the same sex. This type of deviation has also received the greatest amount of theoretical treatment in the literature. In general, explanations focus upon faulty learning of appropriate sex roles during childhood, perhaps coupled with fears of inadequacy in relation to members of the opposite sex. Psychodynamic explanations focus upon failure to resolve the conflicts arising in the Oedipal situation and its effect upon the later identification with significant members of the same sex.

It should be pointed out that in a recent pronouncement of the American Psychiatric Association, homosexuality was removed from the list of forms of psychopathology.

Psychophysiological Disorders

Psychophysiological disorders are diseases of particular organs that seem to result from psychological causes. Some of these diseases can also result from nonpsychological causes, but, in many cases, a nonpsychological cause cannot be found and so a psychological cause is suspected. There are a number of such disorders, four of which are peptic ulcers, asthma, hypertension, and coronary artery disease.

PEPTIC ULCERS

In a peptic ulcer, part of the wall of the stomach is dissolved because of excessive secretion of gastric juices. An ulcer can be quite serious, particularly if the stomach becomes perforated, i.e., if a hole develops. Ulcers have been produced in experimental animals by stressful experiences, for example, as was described in Chapter 14 in the case of the "executive monkeys" of Joseph Brady.

ASTHMA

Asthma is a disorder in which there is difficulty in breathing, caused by a constriction of the smooth muscles of the bronchioles of the lungs. Although it is often caused solely by allergens (substances in the air or in one's food that produce a defensive reaction by the body), it may also be caused by emotional stress. Psychodynamic interpretations have implicated the fear of separation from the mother as a causal event.

HYPERTENSION

Hypertension is a generic term that refers to increased diastolic blood pressure. One form of it is called essential hypertension and can be related to no particular physiological cause. Many investigators believe that essential hypertension is the result of chronic emotional stress. If untreated, it can have a number of potentially severe consequences, including kidney disease and heart failure.

CORONARY ARTERY DISEASE

Coronary artery disease is usually considered to be a medical, rather than a psychological problem. It involves partial or complete blockage of one or

more of the arteries supplying the heart with blood. The blockage is usually caused by the deposition of cholesterol, a fatty substance. Severe stoppage can, of course, be fatal. In recent years Friedman, Rosenman, and their colleagues (1964), have showed that people exhibiting certain behavior patterns (see Table 17.1) were much more likely to have coronary artery disease than individuals exhibiting opposite behaviors. Furthermore, they showed differences in the way these two types of people handled fat taken into the diet. The meaning of these findings is not clear at present, but it would seem that there is a psychological component to the disease, perhaps related to fat metabolism.

Objections to Labeling

The above diagnostic categories are based upon sets of symptoms. On the assumption that symptoms are indices of an underlying disease process, then applying labels to them would appear to be a reasonable way to proceed. A label would give some indication of the disease and inform a knowledgeable person what to expect in the way of prognosis (i.e., how long the disease will last and the chances of complete recovery) and indicate some form of treatment.

If, however, most deviations are best *not* considered as disease entities, as many psychologists assert, then labeling presents a number of disadvantages. First, labeling does not explain anything, although it gives one the false sense of having somehow accounted for the phenomenon that is labeled. The neurotic label, for example, does nothing to explain an individual's deviant behaviors, although if he accepts the label for himself he may in time come to behave as he thinks a "neurotic" ought to behave. Thus the label may serve as a self-fulfilling prophesy.

Second, the label may actually prevent a realistic appraisal of an individual's behavioral problem, since it can misdirect one's attention to some hypothetical underlying disease process, rather than to the actual behaviors

TABLE 17.1 *Personality Patterns of Individuals More (A) and Less Susceptible (B) to Coronary Artery Disease*

Pattern A, More Susceptible	*Pattern B, Less Susceptible*
Poorly defined goals, with a high drive to achieve them	*Little competitive desire*
Eagerly competitive	*Little concern with advancement and recognition*
Desires recognition and advancement	*Little concern with deadlines*
Many, diverse demands on time, with constant deadlines	*Speech, thinking, and motor processes function at relatively steady rate, with little tendency to speed up*
Tendency to speed up speech, thinking, and motor processes	*Placid*
Highly alert mentally and physically	

Source: From Friedman & Rosenman, 1959.

in question. A very revealing example of this possibility, provided by Rosenhan (1973), follows.

Eight normal, well-established individuals with no previous history of psychopathology got themselves admitted to different mental hospitals by reporting that they had had auditory hallucinations. No other symptoms were reported, and in all other respects they behaved normally and responded as truthfully as possible to interview questions, etc. All except one were readily admitted to the hospitals with a diagnosis of schizophrenia, although the reported hallucinations were the only symptoms that they presented. (The other "pseudopatient" received a diagnosis of manic-depressive psychosis.) Interestingly enough, none of the staff ever made note of the obvious normality of these people (in contrast to the astuteness of the other patients in their wards, who readily noted the absence of psychopathology in the pseudopatients). More important, the diagnostic label applied on admission served to color all later observations by the staff of the behavior or these pseudopatients. Behaviors that in any other situation would be considered perfectly normal were interpreted as being caused by the patient's "disorder." Perfectly routine reports by the pseudopatients of significant events in their lives were cast by the psychiatric staff in terms that were compatible with the original diagnosis. Rosenhan quotes from a discharge report of a pseudopatient who had had a rather normal childhood and adolescence (closer relationship with his mother before adolescence, then with his father later) and a warm relationship with his wife (they argued occasionally, as do most couples):

> This white 39-year-old male . . . manifests a long history of considerable ambivalence in close relationships, which begins in early childhood. A warm relationship with his mother cools during his adolescence. A distant relationship to his father is described as becoming very intense. Affective stability is absent. His attempts to control emotionality with his wife and children are punctuated by angry outbursts and, in the case of the children, spankings. And while he says that he has several good friends, one senses considerable ambivalence embedded in those relationships also . . . (p. 253).

Finally, a problem with labels is that they tend to stick, even though they may be misapplied. (Recall the previous discussion of the possible unreliability of diagnoses.) The pseudopatients in Rosenhan's study were, when they were released, given diagnoses of "schizophrenia, in remission." In other words, the possibility that the original diagnosis was wrong was never considered, and these patients will forever, as far as the hospital records are concerned, be schizophrenic, with the continuing possibility that the symptoms may return at any moment.

Summary

Deviant behavior has been approached in a variety of ways throughout the ages. One present-day conception is the medical or disease model, which regards abnormal behavior as caused by some underlying disease process, which is either learned at an early age or is constitutional in nature. The behavioristic view regards deviant behavior as learned reactions to particular circumstances. The phenomenological view considers psychopathology to be caused by discrepancies between one's self concept and his behavior. Deviance is defined in different ways by different cultures, so that there is also a social point of view.

Traditional classifications of deviant behavior include the neuroses, the psychoses, conduct disorders, and psychophysiological or psychosomatic disorders. The neuroses, whose subcategories include anxiety reactions, phobic reactions, obsessive-compulsive reactions, conversion reactions (hysteria), dissociative reactions, depressive reaction, and hypochondriasis, are thought to result from learning to handle anxiety in particular ways. The psychoses include manic-depressive psychosis and the schizophrenias. In all psychoses there is some loss of contact with reality, which may include hallucinations, delusions, disorganized thinking, and motor abnormalities. Manic-depressive psychosis has two poles—mania and depression—and victims may exhibit either one or both, with a cyclic variation between the two extremes. The chances of recovery are good. Subcategories of schizophrenia include simple, catatonic, paranoid, and hebephrenic schizophrenia. Prognosis for individuals whose disorder comes on rapidly, and who have a history of good adjustment, is good. When the disorder comes on slowly, with a history of poor adjustment, the prognosis is poor. Both biochemical and learning explanations for psychosis have been considered.

Conduct disorders include psychopathic personality, addictions, and sexual deviations—behaviors that violate accepted moral codes.

Psychophysiological, or psychosomatic, disorders include peptic ulcers, asthma, hypertension, and coronary artery disease. These diseases may come from other than psychological causes, but there is evidence that in some cases the cause is psychological. The consequences are, nonetheless, physiological and may be quite serious.

There are some objections on the part of psychologists to the labeling of personality deviations, partly because the labels are often unreliably used by practitioners and also because the label may have the function of being a self-fulfilling prophecy, i.e., may cause the person to behave in a way appropriate to the label.

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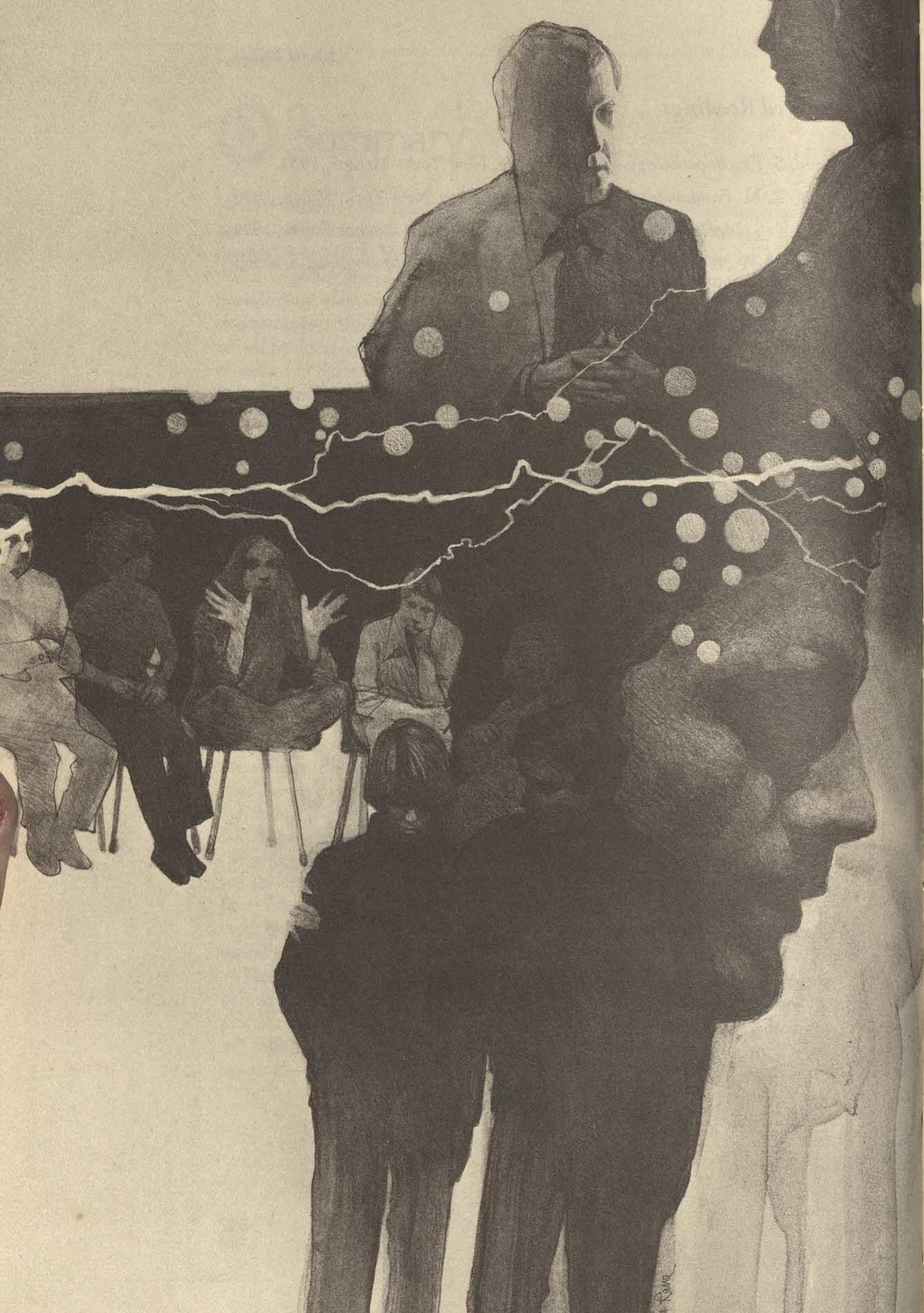

Approaches to Mental Health

18

It is a rare person who has not been bombarded with television, radio, and newspaper coverage of mental health issues. Many individuals have had some direct contact with mental health problems—a relative, a close friend, or an acquaintance may have had some difficulty and may even have been hospitalized for psychiatric reasons. At the level of government, concerted efforts have been made to inform the public about the mental health problem, to alert people to the early signs of mental disturbance, and to foster an improved understanding of individuals who have had personality disturbances.

You have already encountered the matter of personality deviations in Chapter 17. The fact that such deviations exist is the "mental health problem." You have seen that much research and theorizing has been done in an effort to understand the causes of deviant behavior, and that, as yet, we are not very far along in our goal of understanding the problem. Nevertheless, there has been a great deal of activity at the practical level aimed at doing something about it; some of these activities will be described in this chapter.

Most people who have some knowledge of activities in the mental health fields think immediately of three kinds of therapy: psychoanalysis or psychotherapy, mental hospitals, and tranquilizing drugs. Although mental hospitals have been with us for hundreds of years in one form or another, psychotherapy and psychoanalysis are relatively new, at least historically speaking. They have been around for about 100 years. Drug therapy is quite new.

There have been other approaches to the problem as well. The vocational counselor works with individuals who are not necessarily suffering from some psychological disturbance, but who need help in making important decisions such as what kind of vocation to enter, where to go to school, etc. Although

much of this work overlaps a great deal with psychotherapy, the counselor serves a unique function in mental health.

Another recent development is the attempt to teach people to be more skilled in interpersonal relations. Like vocational counseling, the focus is not so much on treating psychologically disturbed people as it is in increasing the sensitivity of normal, healthy people to the expressed and unexpressed needs of other normal, healthy people so that they can function better in interpersonal situations.

Finally, psychologists and others in the field have come to realize that there are distinct limits to what hospitals, individual psychotherapy, drugs, or any of the other approaches, can accomplish relative to the immensity of the problem. Thus the field of "community mental health" has arisen. Many different efforts go under that name, but the task is basically that of providing facilities, methods, personnel training, etc., in such a way that large numbers of individuals may be served efficiently. The focus is often on the prevention of severe problems through early detection, intervention in crises so as to relieve some of the stresses of living, and sensitizing professionals in other areas (nurses, ministers, etc.) to mental-health-related problems.

In this chapter you will learn something of the various approaches to the problem of mental health, including counseling, psychotherapy, drug therapy, hospitalization, community mental health, and human relations training, in that order.

Vocational Counseling

There are several times in each person's life when he must make decisions that are more or less binding for a number of years. When choosing a career, it is possible that you may have to live with the choice for 40 or more years. There is much evidence that a person's sense of identity, feelings of self-worth, and overall adjustment in life are quite closely tied in with his relationship to his work situation. Therefore, promoting a successful adjustment to a life's work is one of the important factors in the mental health movement.

For someone who knows exactly what he wants to do, and who has the necessary intellectual resources, the decision is no problem. Many people, however, are not that fortunate. Their interests, likes, desires, and goals mature later. They may need help in making such decisions as whether to go to college or go to work. Making such decisions may be traumatic, especially when the person does not know much about the possible goals he is considering or about his own aptitudes for doing what he decides to do. Counseling psychologists are trained to help such people by providing as much information as they can about available occupational choices as they relate to their best assessment of the strengths and weaknesses of the client and his range of interests.

ASSESSMENT OF APTITUDES

You have already encountered one important aspect of assessment, that of intelligence, and we shall not have much more to say about it here, except to

point out that it can play an important role in educational decisions, such as whether or not to go to college, and, if so, where to go and what to major in. Intellectual capacity is also of importance when a student appears for counseling about his grades. Low grades can be caused by a number of factors, and intellectual ability is probably one of the more important to consider.

Information about other aptitudes may also be available from tests such as the Differential Aptitude Test Battery or the U.S. Employment Service Test Battery. Grades in particular courses in high school or college may also be useful to the vocational counselor, particularly when they fall into a pattern (e.g., mathematics high, English low, or vice versa).

ASSESSMENT OF INTERESTS

Several test instruments are available that provide useful information about a person's interests. The Strong Vocational Interest Blank, for instance, asks questions about a wide variety of different activities, and compares a person's answers with the answers given by successful people in various occupations (see Figure 18.1). The Kuder Preference Record is another widely used test that also provides a measure of the extent to which one's interests are high or low in a given *general* area such as mechanical problems, music, etc.

EVALUATION OF COUNSELING

Like many other areas in applied psychology, it is quite difficult to evaluate the effectiveness of counseling. Perhaps the most serious problem, which you will encounter in all of the following sections, is that of the criterion for success. Is counseling successful simply because the client says he is happy, or are there other, more objective, indices of success? Unfortunately, the objective indices are hard to demonstrate; therefore, the evaluation of the effectiveness of this and most other procedures to be discussed is less clear-cut than might be desired.

Intuitively, it would seem that a person experiencing difficulty in making important decisions about his life's work would find vocational counseling to be of some benefit; indeed, many former clients speak positively of their sessions with the counselor. However, it should be clear that most of the individuals who appear for counseling do so voluntarily because they feel a need for the information. On the other hand, there is some evidence that providing the information for someone who is not ready to receive it (e.g., in mandatory counseling sessions, either in groups or on an individual basis) is of little use. Myers (1971) reviews much of the literature on the outcomes of counseling, and it appears from his review that the client's motivation is a major factor in determining whether the outcome will be positive.

Psychotherapy

While counseling is for the most part aimed at helping normal, healthy people, psychotherapy attempts to help individuals who are emotionally disturbed to achieve a healthier and happier adjustment to life. The severity of the disturbances with which psychotherapists attempt to deal ranges from mild adjustment problems to severe psychotic episodes. Psychotherapy may

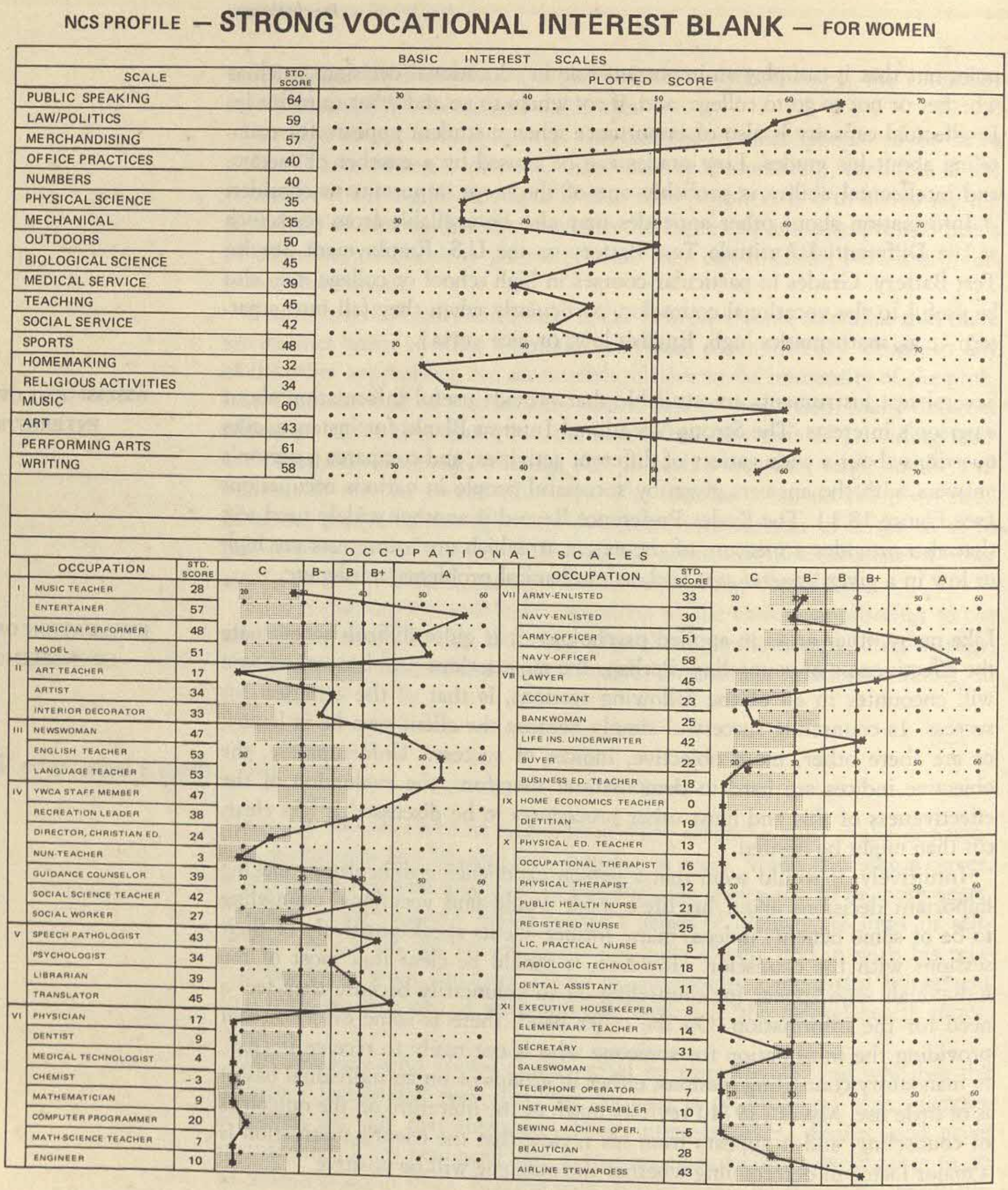

FIGURE 18.1 *A Strong Vocational Interest Blank profile. This particular profile is for a woman college student who would probably be happiest in a position in which she used verbal expression that had the chance of being appreciated by the public at large. In the upper portion her scores are plotted. The double line is the average score obtained by employed women. In the lower portion, her scores on the test are compared with those of successful women in a number of different occupations. The shaded area for each scale gives the range of scores expected by the average woman. Note, for example, that in group I she scored far above average on the scales "entertainer," "musician performer," and "model."*

be used in conjunction with other treatment procedures, such as drug therapy, and is applicable to patients who are hospitalized as well as those who are not. The duration of treatment may range from 1 hour to several years, depending on the psychotherapist, his theoretical orientation, and the difficulties experienced by the patient or client. There are many different theories about psychotherapy, just as there are many different theories about the efficacy of the various approaches.

As you will see later, objective evaluation of the effectiveness of different treatments used is extremely difficult, and much of what is said in this connection must be tentative. For this reason the ratio of opinion and belief to factual data is somewhat higher in this area than in other areas of psychology, and the discussion in this chapter will no doubt reflect that fact.

While any classificatory scheme is bound to be fallible, it is possible to outline four major approaches. To a certain extent these correspond to some of the theoretical approaches to personality discussed in Chapter 17. The overlap is not perfect, however, as you will see. Associated with the *psychodynamic approach* to personality there are *psychoanalysis* and psychoanalytically oriented psychotherapy. This approach is aimed at more or less uncovering hidden conflicts and defenses which, it is argued, prevent the patient from functioning effectively. Associated with the *phenomenological* approach are various psychotherapies aimed at increasing the person's ability to *experience his own psychological states* and his confidence in the validity of his experience and in his efficacy in dealing with his problems. The *behavioristic approach* also has several therapeutic approaches attached to it, collectively called *behavior therapy*. The focus, as you might imagine, is on getting the person to behave in a way that is satisfying to himself and socially appropriate. Another approach, not previously discussed, is aimed at getting the patient to *think* differently about himself. One version of this therapy is called *rational-emotive therapy*, which sees personality disturbances as being the result of ineffective or maladaptive modes of thinking about problems, and attempts by rather direct means to get the patient to change his thought habits. We shall discuss some of the main elements of each of these forms of therapy in following sections.

Psychoanalysis

Psychoanalysis as a form of treatment for personality disorders was developed by Sigmund Freud. As indicated in Chapter 17, he became interested in the possibilities, first exploited by the psychiatrist Breuer, that hysteria could be cured by a process of "talking out," in which the patient would talk about his early experiences. Quite often, Breuer noted, the symptoms would disappear once some traumatic event, usually of a sexual nature, was recalled. Freud went on to spend the rest of his life developing and refining both the theoretical and the practical basis for this form of treatment, and his ideas still provide the basic framework for many modern-day psychotherapists.

Psychoanalysis is more or less joined to the "disease," or "medical" model of personality disturbances, in that disturbed behavior and experience are seen as the result of a pathological process, almost always unconscious, and

rooted in the early experience of the patient. These experiences are assumed to have occurred during one or more of the critical stages of psychosexual development, and the pathological process is usually thought to involve some form of sexual motivation. It often manifests itself as feelings of guilt or anxiety that cannot be pinpointed, or symptoms such as obsessions or compulsions in which the elements of the pathology appear symbolically. Underlying these feelings, however, there is assumed to be one or more conflicts in which the main elements are repressed. The repression serves to reduce anxiety but also requires a great deal of energy that might be spent in other ways more conducive to happiness. The goal of psychoanalysis, then, is to uncover the conflicts in question so that the patient can deal with them consciously and rationally. The three most important procedures for accomplishing this are free association, dream analysis, and analysis of transference.

FREE ASSOCIATION

Free association is a procedure whereby the patient assumes a relaxed position, usually reclining, and says whatever comes to mind. He is instructed that when free associating, anything—even the most trivial, illogical, irrelevant thought—may be of importance in understanding the nature of his unconscious conflicts. In fact, the only way to understand them at all is to piece together bits of information, like the pieces of a jigsaw puzzle, and the analyst is trained to sift every utterance for clues to the unconscious processes to which it may be related.

Of particular interest are topics in which free association is blocked, and, the patient finds himself without anything to say. The analyst assumes that such blocking is the result of repression. The content that would have come out is presumably too threatening and therefore is "censored." Taking note of the material leading up to the blockage is, as you might imagine, often quite informative.

One of the reasons that psychoanalysis requires so much time (2 to 5 hours per week for several years) is that the patient is always avoiding dealing with the important material related to his conflicts. It is not that he does not *want* to cooperate, it is just that he cannot. Repression does not permit the relevant material to appear to consciousness and thus, so far as the patient is concerned, it does not exist.

DREAM ANALYSIS

A patient is also instructed to remember and report on his dreams. The reason for this procedure is that Freud thought that the content of dreams reflected the operation of the unconscious processes that needed to be uncovered. During sleep the control processes that ordinarily keep threatening material from entering consciousness are relaxed somewhat. Since the unconscious processes operate continuously, some of their content enters awareness —a dream occurs.

Even a dream, however, is not usually a direct experience of the unconscious processes, which must always be translated into symbolic terms that have meaning to the conscious life. Thus Freud considered that dreams had two kinds of content: *manifest* content and *latent* content. The manifest content is the dream as experienced. In a nightmare, for example, one might

experience being surrounded by crabs with claws poised and ready to bite. The latent content is what the dream means in terms of unconscious conflicts. The crab nightmare would probably be interpreted as representing castration anxiety due to the failure to resolve adequately the Oedipus conflict (see Chapter 16) during childhood. Rather than imagine actual castration, which would be much too threatening for the dreamer, the fears are *symbolized*, i.e., symbolic representation is substituted for the actual object of the anxiety.

The manifest content of the dream may include events that occurred in the dreamer's recent past. However, the form of the dream is rarely a replica of one's immediate past history. It is usually distorted in some way depending upon its particular relationship to sexually significant conflicts in one's remote past. Thus the dream not only reflects one's actual experience, but also the way that experience is related to unconscious motives and conflicts.

Freud thought that certain symbols referred almost universally to particular threatening contents. Animals or other objects that attack and bite represent castration anxiety. Snakes and other long, narrow objects represent the penis. (They are called *phallic symbols* from the term *phallus*.) Bodies of water and open spaces represent the vagina. Since Freud thought that most important conflicts were sexual in nature, it stands to reason that much of his symbolism would be sexual.

Other psychoanalysts, such as Carl Jung, have a different view of symbolism and lean much less heavily on the sexual aspects of conflicts. The circle, or mandala, for example, is for Jung a universal symbol representing wholeness and eternity. Other symbols represent the male and female aspects of all people, although the meaning is not exclusively sexual. (See Figure 18.2.)

In general, then, dreams are quite important sources of information for the psychoanalyst, regardless of how they are interpreted. (Recall, however, that there are other aspects of dreams that are also of interest to psychologists, as discussed in Chapter 12.)

TRANSFERENCE

In transference, the patient begins to respond to the analyst as though he were some significant person in his life, such as his father. Many of the feelings and emotions associated with the father are then transferred to the analyst. The patient may become very hostile or dependent or seductive; whatever attitude is assumed will depend on the nature of the relationship with the significant person. An analyst is trained to recognize transference reactions and use them in order to find out how the patient feels about certain persons in his life. This is very important information, since many of the conflicts supposedly underlying psychopathology involve these persons. Transference does not usually come until the patient has been in analysis for some time, and is often taken as a sign that he is improving in the sense of being able to bring some of his feelings about other people to the surface. To be sure, they are directed at the analyst rather than at the proper target. However, the fact that they are expressed is taken as a major breakthrough.

Once transference occurs, the patient is then encouraged to recognize and

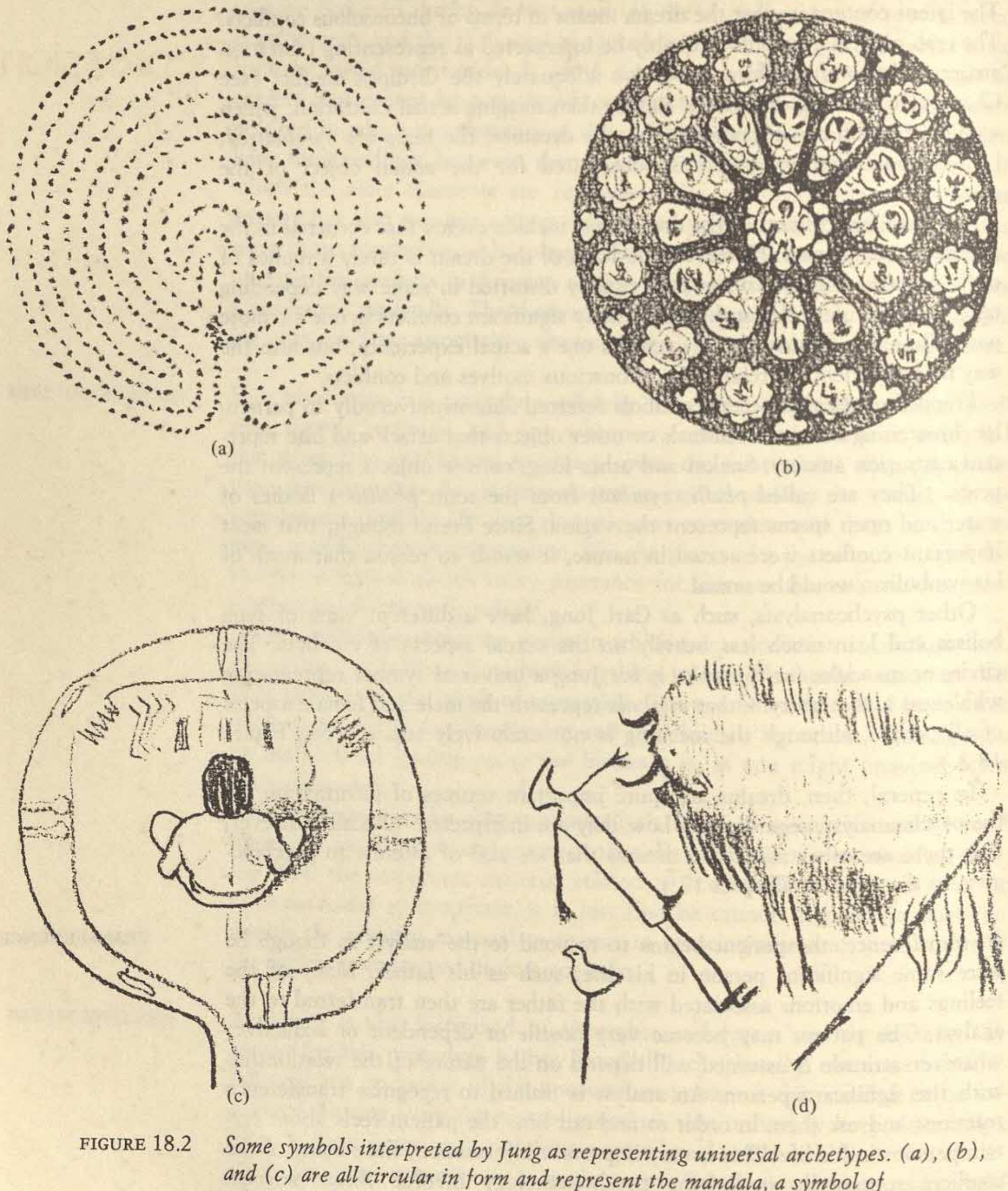

FIGURE 18.2 *Some symbols interpreted by Jung as representing universal archetypes. (a), (b), and (c) are all circular in form and represent the mandala, a symbol of wholeness. In (a) a maze is shown, which also represents the unconscious. Mazes have been in existence from the Bronze Age on to modern times. The rose window in (b) appears in many churches, and is another form of the mandala. In (c), a Navajo indian is undergoing a healing ritual by sitting inside a sand painting, another form of the Mandala. (d) shows another symbol, a bird, which is thought to represent transcendence. This prehistoric cave painting from Lascaux shows a shaman with a bird mask. The same symbolism appears in many other cultures as well (Jung, 1964).*

Psychoanalytic Treatment of Premenstrual Depression

Alexander and French (1946) describe the case of a 32-year-old married woman, who complained of severe premenstrual depression, a condition that had begun about 3 years previously. The symptoms included severe hostility, beginning about a week prior to her period and lasting until about 3 days after her period began. She was treated in 67 sessions over a 10-month period by a female psychoanalyst.

Treatment included interpretation of the patient's verbalizations in psychoanalytic theoretical terms, interpretation of her dreams in these same terms, and analysis of the transference relationship with the therapist which developed about halfway through the course of therapy. Some of the interpretations and highlights of her treatment follow.

She had felt rejected by her mother and very competitive and hostile toward her brother, whose masculinity she envied. She eloped at 17 and had a child at age 18, whom she more or less rejected, and with whom she competed for the attentions of her second husband, who was sexually inadequate.

Her hatred for her brother, her rejection of her daughter, and her presenting symptoms (premenstrual depression) were interpreted as being the result of her identification with her mother who herself had resented her female role and also had hated the son because of his delinquency. Her weak, sexually inadequate husband provided a target for her competitiveness with males (generalized from her competitiveness with her brother) but very little else in the way of satisfaction. It was felt that the patient was simply serving her mother by feeling this way. (Menstrual problems are often interpreted psychoanalytically as a form of rejection of certain aspects of womanhood. These symptoms, incidentally, subsided not long after the analysis began.)

The therapist, being female, became a convenient person to serve as a "substitute mother," i.e., a target for the patient's dependency, someone to make demands on, someone whose permission had to be obtained to make important decisions, and, eventually, someone to take the brunt of her hostility toward her mother. This transference situation provided the basis for bringing into awareness many of the unconscious feelings and motivations already mentioned as they became directed toward the therapist. Part of the transference involved developing a desire to be loved by a woman —a desire of which she was consciously afraid. (The term "homosexual panic" is often used to label this situation.)

One difficulty present throughout treatment was her husband's sexual inadequacy which, coupled with a normal sex drive on her part, did not help matters. Some of the problems in the transference situation hinged on the patient's unconsciously assuming that she needed the permission of her therapist to divorce her husband. Finally, without planning for it with the therapist, she was able to bring herself to separate from her husband. Since the

therapist accepted this action, the patient no longer viewed her as a prohibitive force, and the remainder of the treatment progressed smoothly and rapidly. Taking action without the analyst's permission had been the first step in breaking the dependency, and her actual life situation improved, in the sense that one source of her conflicts was removed. (From Psychoanalytic Therapy. *Franz Alexander and Thomas Morton French, Copyright 1964, renewed © 1974. The Ronald Press Company, New York.)*

deal with the infantile sexual conflicts that are brought to light. Then, presumably, they will no longer trouble the patient and he will be able to function more effectively.

Phenomenological Therapies

As you have seen, the focus of psychoanalytic and other psychodynamic approaches to psychotherapy is upon uncovering the unconscious pathological process that is supposedly disabling the patient. However, there are other approaches that accept the momentary experience of the patient (or the client, as many prefer to call him) at face value. Furthermore, the client must be encouraged to accept his own experience as valid and important, and must be led to believe that he has the potential for making constructive changes in his own life situation. Because of the focus on the client's experience, one version of this therapy is called "client-centered therapy." Its major developer is Carl Rogers (1951).

Client-centered therapy is also called nondirective therapy because the therapist does not actively direct the patient or make suggestions, but serves more as a sounding board or a reflector of the patient's own analysis of his situation. This approach operates on two major assumptions. The first is that the client has within himself the potential for making constructive changes in his own personality. In other words, if therapy is successful, it is the client himself, not the therapist, to whom the success is due. The second assumption is that the therapeutic situation will result in personality changes if the therapist is seen as accepting him (the client) absolutely and unconditionally. Only under such circumstances will the client have the courage to take the responsibility for his own personality changes.

Another form of phenomenological therapy is called existential therapy, a major proponent of which is Rollo May (1961). Existential therapy was developed by psychoanalytically trained therapists who were dissatisfied with psychoanalysis. Rather than focus upon unconscious conflicts, however, the existential therapist assumes that personality disturbances stem from failure to find meaning in life as it is experienced in the present. Thus, like client-centered therapy, one's immediate experiences are important. If one feels that his life is determined and that he has no choice over what will happen to him, then, for him, that state of affairs is true. The goal of therapy would be to lead the patient to a more realistic understanding of the ways in which

Client-Centered Therapy

The following excerpt from a therapy session (Rogers, 1961, pp. 92–94) illustrates the client-centered approach, in which the therapist (T) offers a minimum of interpretation. Rather, as you can see in his responses his approach is mainly to reflect the client's (C) expressed feelings.

C: *You know over in this area of, of sexual disturbance, I have a feeling that I'm beginning to discover that it's pretty bad, pretty bad. I'm finding out that, that I'm bitter, really. Damn bitter. I—and I'm not turning it back in, into myself—I think what I probably feel is a certain element of "I've been cheated." (*Her voice is very tight and her throat chokes up.*) And I've covered up very nicely, to the point of consciously not caring. But I'm, I'm sort of amazed to find that in this practice of, what shall I call it, a kind of sublimation that right under it—again words—there's a, a kind of passive force that's it's pas—it's very passive, but at the same time it's just kind of* murderous.

T: *So there's the feeling, "I've really been cheated. I've covered that up and seem not to care and yet underneath that there's a kind of a, a latent but very much present* bitterness *that is very, very strong."*

C: *It's very strong. I—that I know. It's terribly powerful.*

T: *Almost a dominating kind of force.*

C: *Of which I am rarely conscious. Almost never. . . . Well, the only way I can describe it, it's a kind of murderous thing, but without violence. . . . It's more like a feeling of wanting to get even. . . . And of course, I won't pay back, but I'd like to. I really would like to. . . .*

. . .

C: *I have the feeling it isn't guilt. (*Pause. She weeps.*) Of course I mean, I can't verbalize it yet. (*Then with a rush of emotion*) It's just being* terribly hurt!

T: *M-hm. It isn't guilt except in the sense of being very much wounded somehow.*

C: *(*Weeping*) It's—you know, often I've been guilty of it myself but in later years when I've heard parents say to their children, "Stop crying," I've had a feeling, a hurt as though, well, why should they tell them to stop crying? They feel sorry for themselves, and who can feel more adequately sorry for himself than the child. Well, that is sort of what—I mean, as though I mean, I thought that they should let him cry. And—feel sorry for him too, maybe. In a rather objective kind of way. Well, that's—that's something of the kind of thing I've been experiencing. I mean, now—just right now. And in—in—.*

T: *That catches a little more the flavor of the feeling that it's almost as if you're really weeping for yourself.*

C: Yeah. And again you see there's conflict. Our culture is such that—I mean, one doesn't indulge in self-pity. But this isn't—I mean, I feel it doesn't quite have that connotation. It may have.

T: Sort of think that there is a cultural objection to feeling sorry about yourself. And yet you feel the feeling you're experiencing isn't quite what the culture objected to either.

C: And then of course, I've come to—to see and to feel that over this—see, I've covered it up. (Weeps) *But I've covered it up with so much* bitterness, *which in turn I had to cover up.* (Weeping) That's *what I want to get rid of! I almost don't* care *if I hurt.*

T: (Softly, and with an empathic tenderness toward the hurt she is experiencing) *You feel that here at the basis of it as you experience it is a feeling of real tears for yourself. But* that *you can't show, mustn't show, so that's been covered by bitterness that you don't like, that you'd like to be rid of. You almost feel you'd rather absorb the hurt than to—than to feel the bitterness.* (Pause) *And what you seem to be saying quite strongly is, I do* hurt, *and I've tried to cover it up.*

C: I didn't know *it.*

T: M-hm. Like a new discovery really.

his life is in fact determined. Then a realization of areas in which choices leading to goals of value to him can be made. In short, the aim is for the patient to regain some sense of meaning for his life and his own control over it.

There are many other variants of this approach to therapy. One of its hallmarks is the unwillingness to be tied down to particular theoretical constructions about people and particular methods for dealing with them; so, as you would expect, there is a great deal of individualism in this area. The one common point, however, is the assumption that the patient's experience —what he is aware of at any particular time—is of supreme importance. A corollary of this point is that the present, the "here and now," is more important than events that may have occurred in the past. The present and the way it is experienced is to be dealt with as it is described by the patient, rather than be explained in terms of processes and conflicts of which the patient is unaware. No one is assumed to know the patient better than the patient himself, and a therapist does not present himself as knowing any more about the patient than he, the patient, tells him.

The time course of this therapy tends to be much shorter than for psychoanalysis. As indicated by studies using *Q*-sort techniques (see Chapter 16), many clients begin to experience improved feelings about themselves after only a few sessions with the therapist, and, perhaps as a result, may begin to show major personality changes.

Behavioristic Therapies

Both psychoanalytic and humanistic brands of psychotherapy consider that the behavior of the patient can only be understood in terms of his feelings,

cognitions, conflicts, etc. Since the psychoanalytic approach is that neurotic behavior is caused by conflicts, a focus on the behavior of the patient would be analogous to a physician's treating the symptoms, rather than the cause of a disease. Cough syrup is not likely to help a patient with tuberculosis, and symptomatic treatment of personality disturbances is not likely to alleviate the underlying conflicts. From the phenomenological point of view it is absurd to teach a patient to behave in a way that is incongruous with his feelings. Such a procedure would simply increase, rather than decrease, his sense of alienation.

In spite of these dire warnings it is safe to say that the most rapidly developing approach to treatment of personality disturbances today is based quite extensively on behavioristic principles. The techniques of classical conditioning, instrumental learning, and avoidance learning that were discussed in Chapter 7 have all been employed with at least as much success as that achieved by other forms of therapy.

Behavioristic therapies are like the phenomenological approach in one respect. The focus is on the present. Behavior occurs, so to speak, in the here and now; if a patient would like to behave differently, there are well-developed ways to change his behavior. Behavioral therapy is also like psychoanalysis and other psychodynamic approaches, in that it is assumed that neurotic patterns are the result of past learning. However, unlike psychoanalysis, it is thought to be of little value to uncover the past learning, since it can be supplanted by learning in the present.

There are several techniques used by the behavior therapists, which are, basically, little different from the techniques you have already learned about in Chapter 7. Undesirable behaviors are either extinguished or eliminated through aversive conditioning. Desirable behaviors are shaped with the use of positive reinforcement. Internal responses such as anxiety may be eliminated through counterconditioning of an incompatible response.

EXTINCTION

Perhaps the easiest way to eliminate an undesirable behavior is to cease reinforcing it. As you know, a response that is no longer reinforced is eliminated from the repertoire. In recent years there have been several attempts to reduce disruptive behaviors in classrooms by this means. In many cases it has been found that it is the teacher who reinforces the disruptive behavior, usually by paying attention to it and, at the same time, not noticing positive behavior. Thus, for someone who wants attention, disruption may be the most direct way to get it. Surprisingly, however, it has proved extremely difficult to get some teachers to deviate from their usual pattern of calling down disruptive students and ignoring the good students. Rewarding positive behavior seems to be particularly aversive to some teachers.

AVERSIVE CONDITIONING

Another way to eliminate undesirable behaviors is associating the behavior with punishment. As an example of this approach, consider the problem of treating homosexuals. (Of course, some homosexuals do not wish to be treated. The fact that one appears for treatment, however, indicates that he wishes to do something about it). Feldman and MacCulloch (1964, 1965)

tried the following approach with male homosexuals. They showed them slides of seminude and nude males and females. The subject had a switch with which he could control the presentation of the pictures, but he also had an electrode attached to him so that the therapist could shock him. If a male picture was shown, the patient had to throw the switch to remove it very quickly or else he would be shocked. When the male figure disappeared from the screen, a female figure appeared, and there was no shock associated with these pictures. After about 15 sessions, each lasting around 20 minutes, they found that 11 out of 19 patients were no longer homosexual. The procedure did not work for 5 other patients. (The remaining 3 patients had not finished the procedure when the article was written.)

POSITIVE REINFORCEMENT: TOKEN ECONOMIES

In many cases the problem is not so much to eliminate undesirable behaviors but rather to encourage and promote positive behaviors of various sorts. As you learned in Chapter 7, one way to do this is to reinforce the behavior in question. In one hospital situation, arrangements were made so that the patients could earn tokens for performing various jobs and, in general, engaging in behaviors that would promote their adjustment outside the hospital (e.g., engaging in conversation, avoiding schizophrenic uncomprehensible verbalizations). The tokens could be exchanged for various reinforcers, such as a room in which they could be alone, television, small luxuries, etc. When receiving the tokens was made contingent on performing the desired behaviors, the incidence of the positive behavior increased dramatically. The investigators (Ayllon & Azrin, 1968) thus showed that the use of positive reinforcement could alter drastically the total pattern of behaviors observed in the hospital situation.

Positive reinforcement is also used widely in the setting up of individual programs for self-modification by clients who have rather specific goals, such as losing weight, quitting smoking, or increasing social skills (Watson and Tharp, 1972). Furthermore there has been some success with autistic children who seem otherwise completely unresponsive to attempts by adults to influence their behavior (Lovaas et al., 1967).

COUNTER-CONDITIONING

Recall from Chapters 7, 12, and 14 that emotions such as fear can be viewed as conditioned responses to particular external stimuli. Thus, for example, the fear of snakes may be considered as a conditioned emotional response to a particular stimulus (a snake). One investigator, Wolpe (1958), a pioneer in the development of behavioristic therapy, determined that it should be possible to eliminate such conditioned fears by conditioning an opposing emotional response to the same stimulus. Actually, this procedure was first used by Watson with the boy Albert, who, you will recall, was first trained to be afraid of a white rat, and then the fear was eliminated by presenting the rat in the presence of ice cream.

Wolpe's method of treating fears, or phobias, is to train his patients to relax thoroughly in the presence of the feared stimulus. The idea is to begin with a stimulus that is only slightly similar to the feared stimulus. Sometimes the patient begins by only imagining the stimulus. In either case the actual

Behavioristic Therapy of Extreme Agorophobia

Wolpe (1958) describes a case in which a 23-year-old woman was so fearful of open spaces, of falling, and of encounters with people that she was bedridden for most of the day. Unlike many behavior therapy treatments, this treatment procedure lasted for 4 years. The woman was quite dominated by her mother, with whom she lived, and who had cared for her every need since she was born. The therapist taught the patient quite soon (she was eager to learn) how to stand up for herself in encounters with her mother. Treatment of the fear of falling and of open spaces was another matter, however.

The treatment involved the client's getting into a comfortable position and then imagining falling (or, later, moving away from a wall into the center of a room) in a way that was only mildly anxiety-provoking. Once she reported the particular image to be well-developed, the therapist presented a mild shock to her forearm, which she could turn off by a quick flexion of the arm. The idea was that conditioning a well-defined motor response to occur in the presence of an anxiety-provoking stimulus (i.e., the image of the feared event, in this case, falling or going to the center of a room) would produce a reduction in the anxiety. The new response is presumably partly incompatible with the anxiety, and therefore substitutes for it.

In the treatment of the client in question, the therapist had her imagine making successively larger falls, beginning with a very easy one, falling sidewise onto the mattress on which she was sitting. After she reported that imagining a particular fall was less disturbing, she would then actually practice that fall, and then move on to a slightly more difficult fall. By the end of 10 months she was able to fall directly onto the floor without anxiety. At the same time as she was learning to fall, she was increasing her mobility around the house and enjoying her freedom.

Fear of open spaces, interpreted by Wolpe as fear of going very far away from supporting objects (walls, etc.) was treated in much the same way. She began by sitting at a spot in the room that was as far away from the wall as she could get without feeling any discomfort. At first this distance was about 18 inches. She then imagined standing up at a distance 1 inch farther away, and the shocks were applied. She then stood, actually, at that farther distance. Then, sitting, she imagined herself moving farther out. About 1 year later she was able to stand comfortably anywhere in the room.

The client had brought herself to move away from home, and was able to get about, with help, on the city streets. Finally, she was able to walk on the streets by herself. She obtained a job and was reported as quite happy. The total treatment had required 185 sessions.

Without going into the question of whether some other form of treatment

might have worked better, the main characteristics of this approach were (1) little concern for how she got that way, except insofar as her present situation may have served to perpetuate many of the problems, and (2) conditioning, through a very gradual method of successive approximations, a response incompatible with the emotional response presumably causing the difficulty.

stimulus or the instructions to imagine it are presented, along with instructions as to how to relax completely. Since the first stimulus used may be expected to produce only a small amount of anxiety, relaxation in its presence should be relatively easy. Once the patient can remain relaxed for the weak stimulus, a stronger stimulus—more like the feared stimulus, and producing more intense anxiety—is presented. Again, relaxation is trained. In this way the anxiety-producing nature of the stimulus is gradually increased until the patient is able to relax in the presence of even the most feared stimulus. Patients with strong fears of snakes, for example, have been *desensitized* so that they were able to put their hand in a boa constrictor's cage and pet it or pick it up.

MODELING

As was indicated in Chapter 16, a major source of behavior change in people is the observation of that behavior in other people. Children imitate, or model, the behavior of their parents and of other children; many adults model the behavior of other adults. Modeling also plays an important role in the treatment of behavioral disorders, in the sense that the patient may model the behavior of the therapist. (According to Bandura (1971) this is unfortunate, since the behavior of therapists who use psychoanalytic or other interview types of techniques is certainly not going to be of use to the patient outside the therapeutic situation. Probing into other people's conflicts and giving evasive answers to their questions is at best annoying, and certainly is not likely to promote the social adjustment of the patient.)

There are a number of examples of the explicit application of modeling to the treatment of behavior disturbances, many of which are reviewed by Bandura (1971). The idea is to provide examples of the appropriate behavior, which would promote the well-being of the patient outside the clinic. While there has been relatively little made of this approach in the treatment of adult patients, these techniques are quite widespread in the treatment of children. The procedures used by Lovaas et al. (1967) make extensive use of modeling as well as of positive reinforcement. For example, in attempting to get nonverbal autistic children to learn language, therapists have presented them with sample sounds and then reinforced successive approximations to making the sounds. In this way some children have been induced to learn and use a number of new words, and to communicate in ways that had previously been thought impossible.

In another study (Sarason & Ganzer, 1967) delinquent boys were taught to model socially appropriate behaviors, such as responding to adults in

authority and making positive comments. The result was that they had considerably fewer encounters with the law, and, when such encounters occurred, they received less severe punishment, than a group of control subjects not receiving such treatment.

The approach has also been used in attempts to reduce fears, such as of snakes. Viewing a model handling a snake can in some cases reduce the fear of subjects and even induce them to handle snakes, as occurred in desensitization as described above.

Proponents of behavioristic therapies have offered some rather impressive statistics regarding the effectiveness of their approaches. Considering only the short term effects, "cure rates" range from 70 to 90 percent, depending on the method and the investigator. However, when patients are evaluated over a longer period of time, say, 1 year, the improvement scores drop somewhat, since the improvements in some patients seem to be only temporary. Nevertheless, according to investigators, such as Krasner (1971) and Eysenck and Beech (1971), even in the long-range aspects behavior therapies show somewhat better success than analytic and similar therapies.

You should be aware, on the other hand, that most therapists select their patients and have their own ideas as to what constitutes "improvement." Consequently, it is difficult if not impossible at the moment to make any valid comparison of the various methods.

There is some suggestion (Eysenck & Beech, 1971) that there are limits to the applicability of behavior therapy. They review a considerable amount of evidence, some of which indicates that desensitization, one of the most popular forms of behavior therapy, does not work very well with patients showing an extreme amount of anxiety, or whose phobias involve several different objects. In particular, it has been difficult to help those with acrophobia (fear of heights). Milder fears and specific phobias seem to be quite amenable to this form of treatment, however.

Economically speaking, it seems that behavior therapy has an advantage over, say, psychoanalysis, since most treatments are completed after several sessions. Some problems may necessitate longer periods of time, on the order of months, but even so the time difference is considerable. Furthermore, it is quite clear that instigating programs such as token economies offers the hope of treating a large number of people at once, whereas with individual therapy there simply are not enough professionals to go around, and few people could afford them if there were. The effectiveness of mental hospitals, detention homes, and prisons must certainly be enhanced by the use of these procedures.

The fact that behavior therapies focus on symptoms has led many therapists of other schools, especially psychoanalysts, to argue that the removal of symptoms will be of no avail. They say that if you remove one symptom, another one is likely to appear, and it may be worse than the one that was removed. This fear follows rather naturally from their focus on the underlying conflict that is supposedly responsible for the symptom. Since the conflict is presumably still there, it must express itself in some way, and therefore a new symptom will appear. However, behavior therapists argue that there

is little if any evidence that the removal of one symptom results in substitution of another. In fact, some studies have shown that behavioral changes induced by behavior therapy are followed by changes in the way the client views the world—the behavioral changes lead to cognitive and attitudinal changes (Bandura, 1971). You will see in the next chapter that such changes in attitudes resulting from behavioral changes are rather common. It is as if the person says to himself: "I am behaving in this way, therefore, I must think this way." The main point is that changing behavior may itself change the conditions within the patient that resulted in the symptom and, even if it does not, there is no empirical basis for the idea of symptom substitution.

Rational-Emotive Therapy

How many times have you talked yourself into being angry about something, or into the notion that someone likes you, or does not like you, or is more or less capable than you are? Most of us spend a good bit of time thinking in ways that have emotional consequences, for the conclusions which we generate are often emotionally positive or negative. Albert Ellis (1962) has developed a form of psychotherapy based on the idea that many of our emotional problems are the result of illogical, irrational thought processes, and that a patient can, if his therapist takes the right approach, rid himself of many of these illogicalities. If he does so, he will feel better, and disturbed behavior will be reduced.

One illogical idea which plagues many people is that it is necessary to be liked by everyone. A person who feels that he needs to be liked by everyone is bound to be frustrated, since the achievement of this goal is impossible. If he can be convinced that such a need is illogical, and taught to think differently about his relationships with other people, he will be much better off. Another such idea is that one has to succeed in everything he does, and a third is that one has no control over his feelings or events that are important to him. Thus events and feelings seem simply to happen, and are not at all determined by his own actions.

Obviously, not all people are troubled by the same illogicalities. The task of the therapist is to determine in what ways a particular patient is thinking illogically, to convince him of his error, and then to teach him different patterns of thought. In order to accomplish this end, the therapist takes a somewhat more direct and directive approach than in psychoanalysis or client-centered therapy. He may suggest that the patient practice thinking about a particular problem in a particular way, and, when an illogicality appears in the patient's discussions with him, he will point it out in no uncertain terms.

EVALUATION

Evaluation of this approach, other than on purely rational grounds, is difficult, especially since it has relatively fewer adherents. Opponents have argued that "correcting" a person's thinking will not alter the underlying problem, especially if he is simply following the advice of someone else (as opposed to coming upon a solution by himself). This argument is similar to the one advanced against behavior therapy and has the same weaknesses. Just as

Rational-Emotive Psychotherapy

The goal of Rational-emotive Therapy is to determine the irrational assumptions on which the client's behavior is based, to convince the client of these assumptions, and to instill in the client new, more psychologically healthy assumptions. Albert Ellis (1971, pp. 228–231) conducted the therapy sessions partially transcribed below in which a young woman is having trouble with guilt feelings about not doing what her parents expect.

C[49] *And now I try to break away. For instance, they'll call up and say, "Why don't you come Sunday? Why don't you come Friday?" And if I say, "No, I'm busy," rather than saying, "No, I can't come, I will come when it's convenient," they get terribly hurt, and my stomach gets all upset.*

T[50] *Because you tell yourself, "There I go again. I'm a louse for not devoting myself to them!" As long as you tell yourself that crap, then your stomach or some other part of you will start jumping! But it's your* philosophy, *your* belief, *your* sentence to yourself—*"I'm no goddamned good! How could I do that lousy stinking thing?"* That's *what's causing your stomach to jump. Now that sentence is a false sentence. Why are you no goddamned good because you prefer you to them? For that's what it amounts to.* Who said *you're no damned good—Jesus Christ? Moses? Who the hell said so? The answer is: Your parents said so. And you believe it because they said so. But who the hell are they?*

C[51] *That's right. You're brought up to believe that everything your parents say is right. And I haven't been able to loose myself from this.*

T[52] *You haven't* done *it. You're* able *to, but you haven't. And you're now saying, every time you call them, the same crap to yourself. And you've got to see you're saying this drivel! Every time a human being gets upset—except when she's in physical pain—she has always told herself some bullshit the second before she gets upset. Normally, the bullshit takes the form, "This is terrible!"—in your case, "It's terrible that I don't want to go out there to see them!" Or people tell themselves, "I* shouldn't *be doing this!"—in your case, "I* shouldn't *be a selfish individual!" Now, those terms—"This is terrible!" and "I* shouldn't *be doing this!"—are assumptions, premises. You cannot sustain them scientifically. But you* believe *they're true, without any evidence, mainly because your parents indoctrinated you to believe that they're true. . . .*

C[59] *I get so mad at myself for being so illogical.*

T[60] *Now, you see, there you go again! Because you are not only saying that you* are *illogical, but that you* shouldn't *be. Why* shouldn't *you be? It's a pain in the ass to be illogical; it's a nuisance. But who says it's* wicked *for you to be wrong? That's what you're saying—that's* your *parents' philosophy.*

C[61] *Yes, and also there's the matter of religion. I was brought up to be a strict, hard-shelled Baptist. And I can't quite take it any more. This has*

been going on for—(pause) *Well, the first seeds of doubt were sown when I was in high school. Nobody answered my questions. And I kept asking the minister, and he didn't answer my questions. And when I went to college, I started reading. I tried very hard, the first two years in college. I went to church all the time. If I had a question, I'd ask the minister. But pretty soon I couldn't get any answers. And now I really don't believe in the Baptist Church.*

T[62] *All right, But are you* guilty *about not believing?*

C[63] *Not only am I guilty, but the worst part about it is that I can't quite tell my parents that I don't believe.*

T[64] *But why do you have to? What's the necessity? Because they're probably not going to accept it.*

C[65] *Well, they didn't accept it. I was going to get married to a Jewish fellow as soon as I graduated from college. And, of course, the problem of religion came up then. And I didn't stand up for what I believed. I don't know; rather than have scenes, I took the coward's way out. And when I spend Saturdays and Sundays with them now—which is rare—I go to church with them. And this is what I mean by lying, rather than telling the truth.*

T[66] *I see. You're probably going to extremes there—going to church. Why do you have to go to church?*

C[67] *I always hate to create a scene.*

T[68] *You mean you always sell your soul for a mess of porridge?*

C[69] *Yes, I do.*

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changes in thinking and feeling may follow from changes in behavior, it seems reasonable that changes in behavior and feeling may follow from changes in thinking. Thus feelings, behavior, and thinking, are not causally related to one another in a manner described by a straight line. Rather, each of them affects the other, as indicated in Figure 18.3. Viewed in this way, therapy may be successful if successful intervention is achieved at any of the three points. Which of the points will be the easiest to deal with will depend on both the patient and the therapist.

Other Approaches

ECLECTICISM

Most psychotherapists do not consider themselves to be adherents of any particular school of psychotherapy. Rather, they use a variety of techniques, depending on what they think is best for a particular patient. Such an approach is said to be eclectic, since it selects from a variety of procedures. A therapists's treatment of a patient may include elements of psychoanalytic free association techniques, acceptance of the patient's ability to determine his own course of action (client-centered therapy) and, perhaps in the early stages, attempts to direct the patient's thinking toward more positive elements of his own personality.

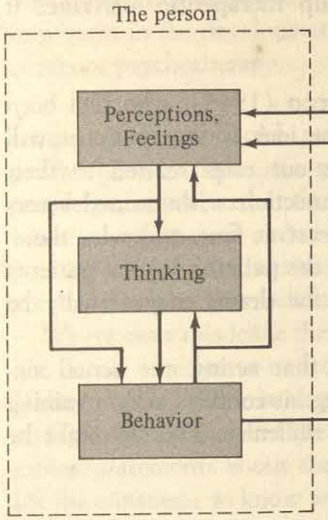


FIGURE 18.3

Some of the ways in which perceptions and feelings, thinking, and behavior are interrelated and related to external events, including people and objects. Note that alteration of any of the "connections," indicated by the arrows, will alter the whole system, including the functions within the person as well as things outside.

Eclecticism does not usually extend to behavior modification techniques, however, except perhaps in the treatment of children, where modeling, positive reinforcement, and aversive therapy may be employed along with other methods.

GROUP THERAPY

Many therapists are finding that some patients function better when therapy is conducted with several people at once. A group of 8 or 10 people may meet with the therapist at one time and discuss their problems. The therapist may offer interpretations from time to time, may intervene to keep the discussion focused on a topic or to bring out a particular point, but, in general, remains more in the background than he does in individual therapy. The group situation provides some patients with much-needed support from people other than the therapist, and also permits them to compare themselves with and relate to other people in a protected environment. These features of the group are, of course, not available in individual therapy and have led to the popularity of the group approach. Sometimes group therapy is used in addition to individual therapy, or as a sequel to it.

A recent development is the marathon group, in which the participants get together for an extended period of time, say, a weekend, without breaks except for meals and other biological necessities. According to proponents of this approach, the fatigue resulting from the length of the session does much to reduce the person's defenses and makes him more open to the possibilities for constructive personality change. There are occasions, however, when people have become quite disturbed psychologically as a result of participation in such groups, and a great deal of care is necessary in screening par-

ticipants beforehand and in providing follow-up therapeutic assistance if necessary.

PSYCHODRAMA

Psychodrama is a technique developed by Moreno (1946), who had been involved in theatrical work for some time. The idea is that patients will show improvement if they are allowed to act out roles related to their particular problems. They do this often in connection with trained actors who assist them in expressing themselves, at least at first, and who themselves play roles of individuals of importance to the patient. Several patients are usually involved in the psychodrama, and the drama may actually be performed before an audience.

The assumption underlying psychodrama is that acting out actual significant roles will aid the patient in understanding his conflicts and in gaining conscious access to areas in which he is having difficulty. Thus it might be considered as an adjunct to psychoanalysis.

General Evaluation

The preceding discussion has more or less assumed that each of the various forms of therapy is effective in its own way, in much the same way that diseases may be treated in various ways. A proponent of a particular method will certainly argue that his approach is effective more often than not, and his argument is usually based on his own assessment of psychological change in his patients, together with the patient's own report of change. For some, the fact that many clients are satisfied with the results is proof enough of the efficacy of therapy.

It is appropriate at this point, however, to raise some general issues with regard to the effectiveness of psychotherapy. Although, as you will soon see, we cannot answer in a general way the question as to whether "psychotherapy" is effective, the issue must in some way be faced.

SPONTANEOUS REMISSIONS

Scientific method teaches us that evaluation of any treatment must be made with reference to a control group not receiving the treatment. In the case of psychotherapy, any assessment of its effectiveness must compare changes in individuals receiving psychotherapy with those not receiving any treatment. This point was made by H. J. Eysenck in 1952. Using his own assessment of the rate of spontaneous remission (improvement without treatment) of psychological symptoms as a base line, he found that just as many improved without treatment as with psychotherapy. This report created quite a stir among clinicians, for it suggested that psychotherapy was of no demonstrable value. Since that time, as you can well imagine, his report has been attacked on every conceivable ground. One of the major points of attack had to do with his estimate of the spontaneous remission rate which is, of course, very difficult to assess in any clear-cut way. Bergin (1971) in a recent review of this controversy, suggests that Eysenck's assessment of the rate was much too high, and he comes to the conclusion that there is at least *some* evidence that psychotherapy works in some cases.

Like it or not, the issue is still with us, and the controversy has not yet

died down. Regardless of the conclusions, the raising of the issue was quite important in the development of a concern for the empirical validation of the effects of psychotherapy.

NEGATIVE CHANGES

In any profession some practitioners are effective, and some are not. In psychotherapy, there is a good bit of evidence (Bergin, 1971) that some people get worse, rather than better, with treatment. Apparently, some combinations of patient and therapist are particularly good from the patient's point of view, and others are particularly bad. Thus the outcome of treatment may be good, bad, or indifferent depending on the particular combination.

Where does this leave the potential consumer of psychotherapy? How does one decide whether or not to seek a psychotherapist, and, if so, who to go to? Unfortunately, there is no good answer. Although both the American Psychiatric Association and the American Psychological Association have strong ethical statements about the practice of therapy, there is at present no way for the consumer to know what the outcome of his encounter with a therapist will be. An ethical practitioner will terminate the relationship if he thinks that he will be of no benefit to the client, but there is no way of knowing the outcome ahead of time.

AVAILABILITY OF SERVICES

Another criticism of psychotherapy is that it is limited to patients with relatively high incomes, in the upper-middle-class range and above, and is not available at all to the vast majority of people. (At the rate of $50 per hour or more a psychoanalysis requiring 2 days per week for 2 years would cost about $10,000.) This fact is coupled with the finding that psychological symptoms are considerably more severe among the lower socioeconomic classes, and suggests that the services are mostly available to those who need them least. Furthermore, even if everyone could afford it, there would still be not nearly enough therapists to go around, at least for individual therapy as commonly practiced. Also, middle-class therapists have had difficulty in relating to the problems of lower-class clients, and thus, even if everyone could afford it and there were enough therapists to go around, the delivery of services would still be limited to those clients with whom the therapist could relate meaningfully. These issues are by no means trivial, and the community mental health movement, to be discussed presently, has developed partly as an attempt to provide workable solutions.

Physiological Therapies

Psychotherapy and behavior therapy are aimed at personality and behavior change through psychological means. In one way or another the patient is asumed to learn new patterns of behavior. Other forms of treatment that intervene directly in the functioning of the brain are also used. Because they involve doing something to the body in the hope of effecting psychological

changes, they are called physiological, or somatic therapies. They include drug therapy, which is the most prevalent form of therapy, electroconvulsive shock, and psychosurgery.

Drug Therapy

Before the mid 1950s there was very little that could be done with psychiatric hospital patients who happened to be violent and abusive, other than to restrain them with a straight jacket or to tie them to their beds. However, in 1955 there began the use of a new drug, chloropromazine, which started a virtual revolution in the treatment of mental patients. Chloropromazine is one of the so-called major tranquilizers and has received widespread use in the treatment of psychotic patients.

Since that time a number of other drugs have been developed which have psychological consequences and are particularly useful in the treatment of persons with emotional problems. There are at present a variety of tranquilizers, stimulants, sedatives, and antidepressants in use, and it is safe to say that some of these agents are primarily responsible for the continuing reduction in the census of mental hospitals from 1955 on. We shall consider several of these categories of drugs.

TRANQUILIZERS

Tranquilizers are usually divided into the major and the minor categories. Major tranquilizers include chloropromazine and several other compounds used to treat psychotic patients. Chloropromazine is particularly useful in cases of acute schizophrenia (where the symptoms have a rather sudden onset), and its usage permits many patients that might otherwise have to be hospitalized to be treated on an outpatient basis. Side effects include low blood pressure, drowsiness, and blurred vision, but these effects are, of course, considerably less serious than the psychotic symptoms that are alleviated.

It is not known exactly how chloropromazine works, except that its action seems to involve the hypothalamus, particularly some of the areas involved in motivation (see Chapter 12).

Minor tranquilizers include meprobamate (Miltown or Equanil) and Librium and Valium. These drugs are used for mild neurotic symptoms, and in many cases are quite successful in alleviating anxiety. Side effects include dizziness, and there is the possibility of addiction to them.

ANTIDEPRESSANTS

One of the symptoms of some personality disturbances is severe depression. The patient loses interest in things around him, becomes inactive, is quite sad, and may even be suicidal. Several drugs, the original one being *iproniazid,* seem to produce an elevation in mood, increased activity, and increased interest in one's surroundings. Two trade names for antidepressants are Tofranil and Elavil.

Antidepressants seem to work by inhibiting the action of an enzyme in the brain called monoamine oxidase (MAO). This enzyme is responsible for destroying norepinephrine, which is one of the synaptic transmitter substances (Chapter 4). If MAO is inhibited, the result is more norepinephrine

(less is destroyed) available for synaptic activity. Apparently, the depressive state involves a reduction in synaptic efficiency because of depletion of norepinephrine, and the drug counteracts this state.

Unfortunately, the antidepressants seem to work only for certain kinds of depression, the "pure" kind that does not involve additional symptoms such as hostility and severe anxiety. Also such a drug is not likely to benefit one in getting over temporary reactions to the various sad events that occur in everyday life.

SEDATIVES

Sedatives have been used for a long time with some success in the treatment of mild anxiety states. These include sleeping pills containing barbiturates such as nembutal or phenobarbital. The main problems are the side effects, which include drowsiness, the possibility of death due to overdose, the possibility of addiction, and rather severe withdrawal symptoms, including convulsions.

Shock Therapy

Before the development of tranquilizing drugs, there was the possibility that some patients would show improvement if they were thrown into a convulsion by the passage of an electric current through the brain. This form of treatment, known as electroshock therapy, usually produced unconsciousness for a period of time after the convulsion, but, after that, some improvement in functioning. Unfortunately, there is some evidence that brain damage, as well as deficits in learning and retention, are side effects of the shock treatment.

Shock therapy has proved to be most successful in cases of severe depression. In fact, before the antidepressants were brought into the picture, it was the treatment of choice for depressive psychosis. It is still used for this purpose, but there is some indication that its popularity is on the decline.

Insulin is used in another form of shock therapy with somewhat similar effects. Insulin is a hormone secreted by the pancreas, and its major function is to control the rate of intake of glucose sugar into the cells of the body. A large dose of insulin will cause the cells to take up sugar quite rapidly, with the consequent lowering of the level of sugar in the bloodstream. This effect deprives the cells of the brain of its nutrients, and a convulsion and coma result.

No one knows for sure why these procedures work, although the process may involve transmitter chemicals. The convulsion often produces amnesia for events immediately preceding the attack, and perhaps this effect is in some way related to the patient's improvement.

Psychosurgery

Another form of somatic therapy that is still used, but not very widely, is psychosurgery. The procedure is to interrupt the nerve fibers that connect the prefrontal lobes with the thalamus. As a result, the patient who is extremely anxious may show a reduction in anxiety. Unfortunately, there are other symptoms as well, such as loss of the ability to plan ahead, in-

creases in impulsive behavior, and indifference to the opinions of others. This kind of therapy is not used very much now.

Other kinds of brain operations have been tried on an experimental basis, some of which were described in Chapter 4 in connection with a discussion of the role of the brain in violent behavior. In general, there is a great deal of caution in experimenting with human brains at present, and there is no indication that any major breakthroughs are about to occur.

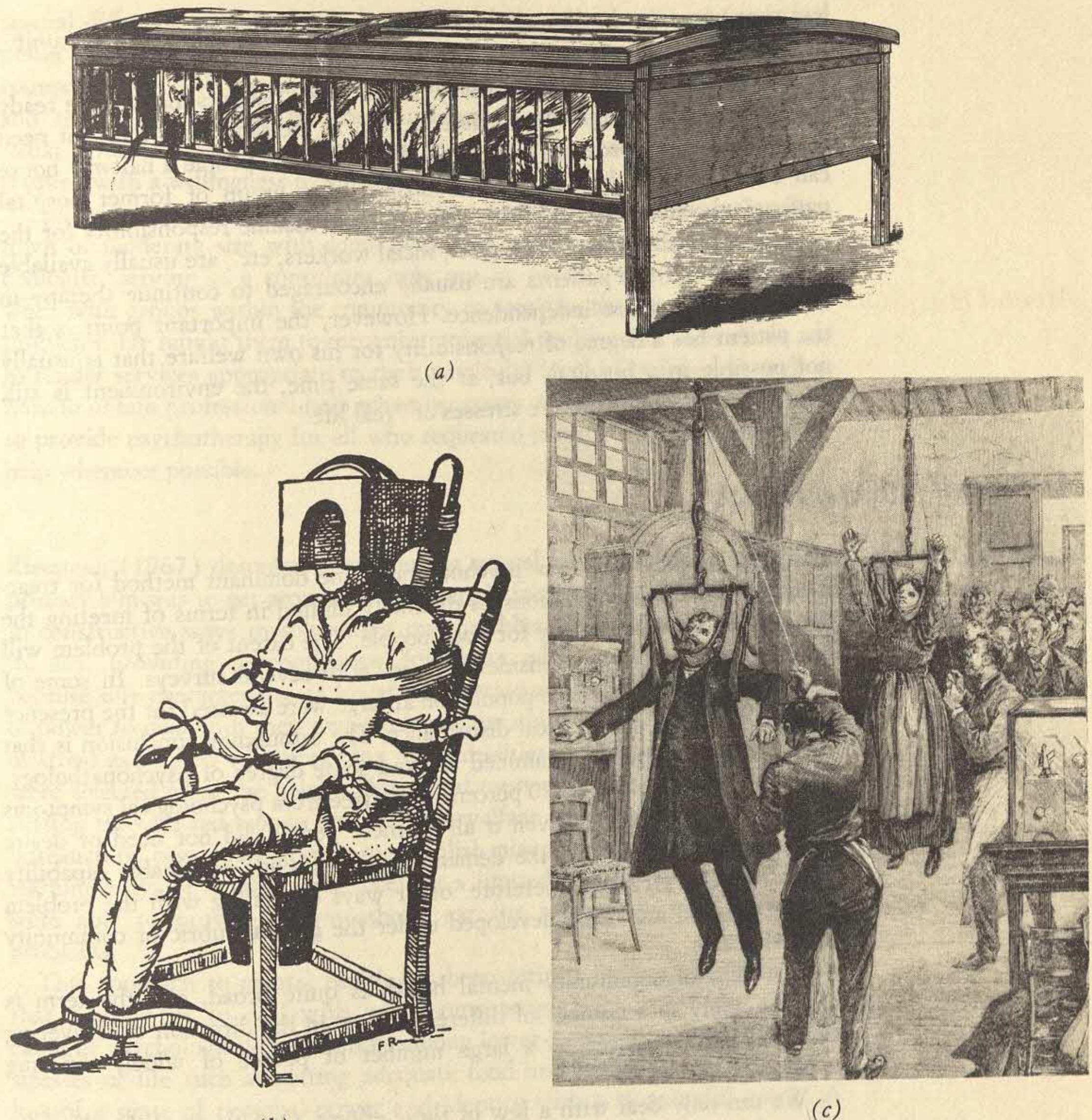
Mental Hospitals

Mental hospitals have a long history, much of which is quite shameful and depressing. Fortunately, however, the situation is improving. In earlier times it was thought that mental illness was the result of possession by evil spirits, and inmates of asylums were treated accordingly. (See Figure 18.4; also Chapter 12.)

For the last century or so the task of providing custodial care for the mentally ill has been assumed by governmental agencies. "State hospitals," which are well known for their crowded conditions, dismal facilities, inadequate staffs, and the bizarre behavior of the patients, were the outcome. More recently, the federal government has provided facilities for psychiatric hospitalization for those eligible for benefits of the Veteran's Administration, with some considerable improvement of the facilities and treatment possibilities. The Community Mental Health Centers Act of 1963 provided for complete facilities for each population area ranging in size from 75,000 to 200,000. These developments, together with other innovations, such as drug therapy, flexible forms of outpatient care, and halfway houses, have contributed to the much brighter picture that we have today.

Even with the improvements that have been instituted in the past several years, however, mental hospitals are still a mixed blessing. On the one hand, they provide a safe place where someone who is in such a disturbed state that he might harm himself or other people can go until the situation (either the patient or his environment) is improved. Also, the hospital environment does not contain many of the stresses that life in a home with other members of the family present would provide, and such freedom from stress may promote improvement. On the other hand, hospitals foster an attitude of dependency and a loss of identity (Goffman, 1961) which, if it persisted over a long time, would make the patient worse rather than better. It was pointed out in the previous chapter that hebephrenic schizophrenia may well be a result of hospitalization, rather than a disorder that could develop in a nonhospital environment. It is a fact that the probability of improvement and release diminishes the longer one stays in a hospital. In recognition of this fact, attempts are now being made to get patients out of hospitals and into the community as soon as possible. To this end several arrangements are now being tried.

First of all, it is recognized that some patients may be able to perform their jobs in the daytime, but should not be subjected to family stresses at



(a) (b) (c)

FIGURE 18.4

Some forms of treatment for the mentally disturbed. (a) A "crib" used in New York in 1882. (b) A "tranquilizing chair" in which the patient's chest, arms, and legs are restrained, and the square helmet worn over the head to keep out distractions, circa 1800. (c) Treatment by suspending the patient. The Bettman Archive.

night. Such patients may, then, work in the daytime and live in the hospital at night. Other patients may be better able to cope with their families than with the pressure of a job, and such people would spend the day in the hospital and the night at home. The assumption in either case is that the

less time spent in the hospital and the more time spent in the community, the better.

Another innovation is the halfway house. Many patients may not be ready for a completely independent existence, but at the same time may not need the complete care provided by the hospital. For such people a halfway house can be helpful. A halfway house consists of a group of former hospital patients who live together, share expenses, and assume responsibility for the governance of the house. Therapists, social workers, etc., are usually available as needed, and the patients are usually encouraged to continue therapy in order to attain more independence. However, the important point is that the patient has a degree of responsibility for his own welfare that is usually not possible in a hospital, but, at the same time, the environment is still relatively protected from the stresses of "real life."

Community Mental Health

You have already seen how psychotherapy, the dominant method for treatment of personality deviations, is distinctly limited in terms of meeting the need for services, especially for poor people. The extent of the problem will become clear when you consider the results of several surveys. In some of these studies samples of the population at large were assessed for the presence of symptoms of psychological disturbance. The astounding conclusion is that one-third of the people examined showed some degree of psychopathology, and very few, about 15 to 20 percent, were free from psychological symptoms (Cowen & Zax, 1967). Even if all of these people did not need or desire treatment, it is clear that the demand far exceeds any reasonable capability to deliver the services. Therefore, other ways of dealing with the problem have been and are being developed under the general rubric of community mental health.

The field of community mental health is quite broad, and the term is used to apply to a number of different efforts in the direction of delivering mental health services to a large number of people of widely differing socioeconomic status.

We can only deal with a few of these efforts. One approach has been to educate personnel in existing public service organizations, such as schools, churches, and welfare agencies, in mental health problems. Another has been to develop neighborhood community mental health centers to organize neighborhoods for purposes of self-help and for temporary intervention in personal crisis situations. A third approach has been to explore the possibilities of training subprofessional personnel to provide counseling for those who need it. We shall briefly examine each of these approaches.

Community Education

Small communities in rural areas somewhat removed from large population centers may be particularly hard-pressed when it comes to mental health services. On the other hand, in the rural community there are usually

several different groups of people who can help. Ministers, social workers, public school teachers, and public health workers may be able to offer counseling that will lessen the immediate emotional problems of individuals and reduce the chances for the development of more serious problems. What is needed is some minimal education as to how to go about this task, coupled with a willingness to undertake it.

Spielberger (1967) describes such a program that was put into effect in a town of moderate size with some degree of success. One professional psychologist, serving as a consultant only one or twice a month, was able to work with groups within the community to sensitize them to mental health problems. He taught them to recognize potential problems in individuals and to render services appropriate to their particular level of training, as well as how to obtain professional help when necessary. Obviously, the aim was not to provide psychotherapy for all who requested it but to provide supportive help wherever possible.

Community Mental Health Centers

Riessman (1967) describes a community mental health center in which the primary aim was to get groups of poor people interested in working together in constructive ways to solve their own problems. This mode (as opposed to, say, providing psychotherapy for those who need it) was selected because one characteristic of lower-class communities is the lack of a sense of power to deal with their own problems, in addition to an unusual amount of stress associated with obtaining the necessities of life. The staff members were selected from the neighborhood and trained to help in such things as cutting through red tape in dealing with welfare officials and public housing bureaucrats, organizing groups to establish playgrounds in vacant lots, and learning ways of making ends meet on a limited budget. In addition, they were able to provide a sympathetic ear for individuals with emotional problems.

This approach to mental health has been termed *primary prevention*, in that it attempts to deal with what some people feel to be the primary cause of psychological disturbances among lower-income people, namely, the stresses of life such as getting adequate food and housing, coupled with a loss of a sense of personal power and identity with a meaningful group. A major feature of this approach is *crisis intervention*, whereby someone is always on call to help in an immediate crisis, such as an impending eviction, loss of a welfare check, or a major illness or accident, which can be much more stressful for someone living marginally than for the more affluent.

Other centers focus on what is called secondary or tertiary prevention. Secondary prevention involves the early identification of individuals with personality problems and the referral of them to appropriate treatment centers. This activity is important in the sense that early treatment may prevent the development of problems that are more difficult to deal with later on. Also, recall that the greater incidence of severe emotional disturbances among the lower socioeconomic classes was mentioned previously. One of the probable reasons for this is that detection and treatment is considerably

delayed among these people, and secondary prevention centers can help alleviate this problem.

In tertiary prevention, attempts are made to help individuals who are in the process of recovering from emotional disturbances in their new adjustment to the community, and thereby reduce the likelihood of a need for further hospitalization.

All three of these functions are important, and it is vital, especially in poorer neighborhoods, that they be available in the neighborhood itself. However, the primary prevention area perhaps promises the most benefit in the long term.

Use of Subprofessional Personnel

The whole discussion so far has implied that the burden of delivery of mental health services must be carried by individuals without complete professional training. The consultant trains professionals in other fields or the mental health center provides training for neighborhood people. While these efforts are obviously not directed at developing professional therapists, there are several experimental programs that have trained lay people to do psychotherapy in limited settings. In one such program (Rioch, 1967) a carefully selected group of housewives were put through a two-year program of training in interviewing and psychotherapy. The aim was to place them in service agencies and hospitals to alleviate some of the demands on the professional staff.

Although there was some difficulty in placing the students after training (not all had college degrees, which government regulations specify), a panel of professionals who evaluated their work at the termination of the training was quite impressed with their proficiency, and the general conclusion was that the program was a success. All students were eventually placed in responsible positions and functioned quite effectively. Such a program, if established in a number of key places, could do much toward alleviating the demand for counselors in hard-pressed agencies. Economically, it seems quite feasible, since subprofessionals would draw considerably lower salaries than psychologists with a large amount of academic training.

Human Relations Training

In the past 10 or 15 years a great variety of practices has emerged, all of which involve small groups of people, and all of which are aimed in some way at the education of nominally normal healthy individuals in interpersonal relations and self-growth. The various groups go by a variety of names, and the techniques used by the leaders of the groups are equally varied. Some groups are led by highly trained individuals, while other leaders have little or no formal training. Aside from the giving and receiving of offhand advice that always takes place between individuals, small group work is probably the most rapidly growing and uncontrolled phenomenon with psychological

implications today. We shall discuss several types of groups that have developed, but our list is by no means complete.

Sensitivity Training

The original group work was begun at the National Training Laboratories in Bethel, Maine, in 1947. The groups, called "T-groups" (T for training), were developed by psychologists interested in the area of group dynamics—the behavior of people in small groups. The intent was to train the members of the group in the development of leadership skills and the ability to work with other people in group situations. The group leader, who should of course be highly trained himself, assumes the job of focusing the attention of the participants on the process of group discussion and resolution of issues (i.e., what is going on in the group), the feelings of the members as they are expressed directly or (usually) indirectly, and in general, the nature of the "here and now" situation in the group (as opposed to what the members have done in the past or will do in the future).

A number of research studies have been performed in an attempt to track the effects of group participation on its members, but it is at present hard to say just what actually happens (Gibb, 1971). There is some indication that in successful groups, competitiveness decreases with time and cooperation increases, but there is no indication that all groups will show these changes. Several studies have evaluated group members after participation in the groups and report increased ability in dealing with others, but also, on occasion, negative changes such as increased irritability and spontaneity, which are likely to annoy associates who have not participated in such groups.

Encounter Groups

The encounter group is a variant of the T-group, in which the aim is a more direct encounter with one's own feelings toward others, and vice versa. Openness and transparency in the group situation are encouraged. Sometimes limited physical aggression occurs in these groups, and it may happen that some one individual becomes a scapegoat for the feelings of the other members, much to his own detriment.

This type of group is quite popular in some circles, and is often seen on college campuses, church organizations, and in connection with social issues such as desegregation. The assumption behind such groups is that overt and honest emotional expression in the presence of (and often directed toward) other people is a healthy practice, at least in the controlled group situation. An opposing viewpoint is that some feelings are best left unexpressed; aggressiveness does not necessarily build up if left unexpressed, and, indeed, its expression may very well trigger additional expression in other circumstances.

Creativity-Growth Groups

In the last 15 years, especially in California, groups designed to "release" one's creativity and "growth potential" have become quite popular. One of the main centers for such groups is the Esalen Institute, Big Sur, California, and there are a number of other "little Esalens" around the country.

Methods for this type of group are probably the most varied of all. They range from fingerpainting, back rubbing and blind interpersonal encounters, in which touch is the only means to communication, to several types of yoga, interpretive dance, and marathon groups conducted in the nude.

Exactly how and how much "creativity" and "growth potential" are "released" through such group experiences is anybody's guess. Many people who participate in such groups swear by them. Many professional psychologists and psychiatrists see the rather unconventional forms of behavior as having great therapeutic potential. Others (e.g., Koch, 1969) feel that they are an affront to human dignity. Many of those who participate in them feel they are valuable, and at this point it is difficult to say much more than that.

Summary

Mental health is a highly publicized area, and in recent years there has been a great deal of support for developing methods for the prevention and treatment of mental illness. The problem has been, and is being, attacked from a number of different angles.

Vocational counseling as an approach to mental health focuses upon helping normal individuals make decisions at important points in their lives, such as choosing a career. The aim is to provide support, as well as information about the individual's interests and aptitudes, and to provide realistic advice about rational alternatives that one could follow. Also, counseling may help individuals who are not performing as well as they could in school work better live up to their potentialities.

Psychotherapy is a form of treatment of personality deviations in which the focus is upon learning new emotional responses, ways of thinking, and patterns of behavior. There are many different types of psychotherapy. Psychoanalysis focuses upon the uncovering of hidden conflicts through the techniques of free association, dream interpretation, and analysis of transference. Various forms of phenomenological therapy focus upon the individual's acceptance of himself as he is, particularly his feelings, and the recognition of his possibilities for constructive change and growth. Unconscious processes, hidden conflicts, etc., are deemphasized, and ways to find meaning in life are emphasized. Behavioristic therapies focus upon changing behavior either through classical conditioning procedures, such as desensitization and counterconditioning, or instrumental procedures including aversive training, operant conditioning using positive reinforcement, and extinction. Rational-emotive therapy focuses upon changing the way the patient thinks about himself and his relations to other people. Most practitioners are eclectic, in that they select from a number of different approaches, depending upon what they think is best in a particular circumstance. There are a number of other forms of therapy, including group therapy in which several people are treated at once and presumably treat each other, and psychodrama, in which the patient

acts out his problems in dramatic productions with the aid of trained actors. All forms of therapy are relatively expensive and quite limited in terms of the number of people who can be treated.

Physiological therapies include the use of drugs, shock therapy, and psychosurgery. The major tranquilizing drug (chloropromazine) is used extensively in the treatment of major personality disorders and has done much to reduce the number of hospitalized mental patients. Minor tranquilizers (meprobamate, Valium, Librium), are used to alleviate anxiety and other neurotic symptoms. Antidepressants (iproniazid and imipramine) are useful in elevating the mood of depressed patients by means of their effect on the metabolism of the neural transmitter norepinephrine. Sedatives (barbiturates) are sometimes used instead of minor tranquilizers for the alleviation of anxiety. In shock treatment the patient is thrown into a coma, usually with convulsions, after which some patients, particularly those exhibiting depression, may show some improvement. The shock may be induced by passing an electrical current through the brain or by lowering the blood sugar level through the administration of insulin. Psychosurgery, which is presently unpopular, but with some indication of increased interest, includes deconnection of the prefrontal lobes of the brain as well as making lesions in other areas of the limbic system such as the amygdala.

Mental hospitals have shown considerable improvement in the last few years, and there are programs aimed at getting patients out of the hospital as soon as possible, including the day-hospital, night-hospital, and halfway houses. Life within the hospital has been criticized because of its fostering of dependency and loss of identity, and because the longer one stays, the less likely he is to show improvement.

Community mental health is a new concept in which methods are being developed for delivery of mental health services to more people than can be reached by traditional methods such as psychotherapy. Approaches include education of professionals in other fields, such as social work and the ministry, to be sensitive to mental health problems, and to deal with them effectively. Also important is the establishment of neighborhood mental health centers in poor neighborhoods, focusing upon getting the people of the community to take on responsibility for solving many of their own problems, dealing with crises, and assuming more active control over their lives (primary prevention); detecting signs of mental illness (secondary prevention), and assisting former mental patients in adjusting to the realities of life (tertiary prevention). The training and use of subprofessional personnel is also an important step in improving mental health services, and several programs have been able to do this successfully.

A number of different kinds of small groups have recently been formed with the aim of increasing people's sensitivity to their own and other people's feelings, and training them in leadership, or in the development of creative potential. T-groups, or sensitivity training groups, are the oldest example of this type. More recently encounter groups, focusing upon open expression of feelings, and creativity-growth groups, focusing upon development of creative potential, have become quite popular.

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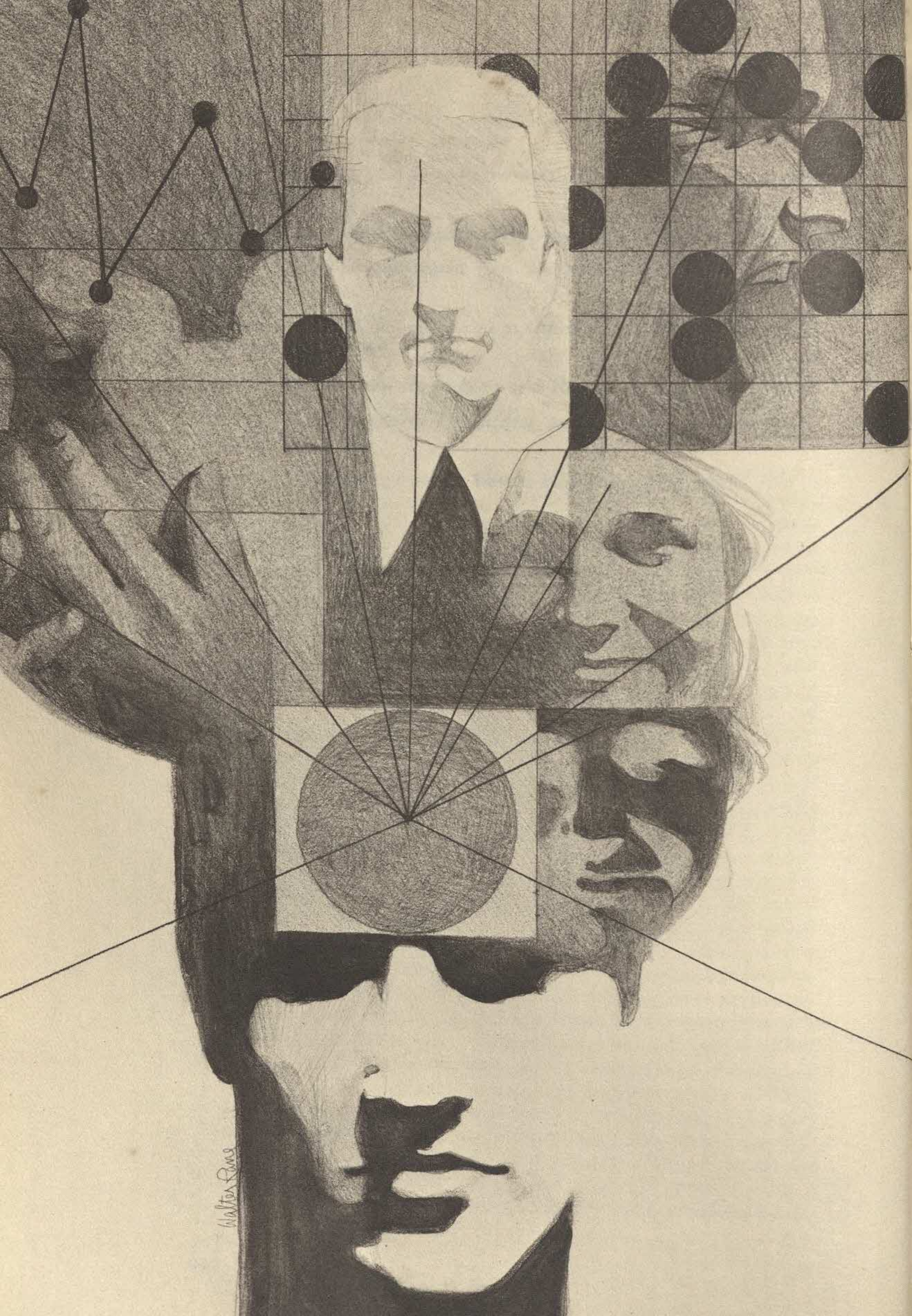

Walter Rane

Social Psychology

19

Social psychology focuses upon behavior in relation to other members of the species, and upon those cognitive, emotional, and motivational processes which determine the nature of that behavior. Although social psychologists have traditionally been concerned with the social behavior of humans, there is an increasing interest in and recognition of the importance of animal social behavior. You have already read of Darwin's *The Expression of the Emotions in Man and Animals*, in which social behavior played an important role. Moreover, there have been countless studies of social behavior in a variety of nonhuman species conducted by biologists, ethologists, comparative psychologists, and naturalists. The work of three such investigators, Konrad Lorenz, Nikolaas Tinbergen, and Otto von Frisch, was recently recognized in the form of the Nobel Prize.

In this chapter the animal research will be ignored in spite of its importance and relevance to an understanding of human social behavior. The problem is basically one of space, and some of the animal research has been discussed in previous chapters. The focus, then, will be on human social behavior, some aspects of which you have already encountered in Chapters 13 and 14.

Human social psychology is an increasingly broad area, and, like personality, encompasses all of the basic processes that you have encountered already, the focus being on how these processes affect social behavior. There are also, however, some unique features of social behavior. People behave differently when they are with people than when they are alone. This chapter will be divided along these two lines. First, we shall consider some of the basic cognitive and motivational processes that operate in social behavior, and then some of the unique aspects of social behavior.

Cognitive and Motivational Aspects

People often act on the basis of what they believe, and both their beliefs and their behavior are systematically selective. Different people are perceived differently; one is disposed to be friendly toward some people, unfriendly toward others; one sees certain behaviors as good, others as bad; one prefers some things to other things. The term *attitude* is used when the selective disposition persists over some period of time. An attitude might include the belief that black people are stoical and have a good sense of rhythm or that large companies are out to soak the public. These beliefs are often accompanied by *emotional responses* toward the object. The attitude that "Black is beautiful" includes having positive emotional feelings when one sees a black person. An attitude may also include a *tendency to act.* The belief that big business is bad may cause one to vote for candidates in favor of antitrust action, and perhaps to patronize small businesses.

A negative attitude toward a group of people is called *prejudice.* The term means *pre-judge*, and technically should refer to both positive and negative attitudes, but social psychologists have usually considered only the negative side. Whether positive or negative, however, prejudice means that response to a person more or less ignores his individuality and focuses upon his membership in a particular group.

Understanding why people believe the things they do has occupied the energies of social psychologists for some time. As a result, there are several theories of how beliefs and other cognitive factors in social behavior are organized. It seems to be generally agreed that people are motivated to arrange their beliefs so that they are consistent with one another and with their behavior. That is, *cognitive consistency* seems to function as a motive. We shall first consider some theoretical approaches to cognitive consistency. Then we shall deal with some of the factors influencing how people perceive each other, attraction between people, and the process of attitude formation and change through persuasion.

Cognitive Consistency

BALANCE THEORY

Balance theory was formulated by Fritz Heider (1958). The main idea is that people's likes and dislikes toward each other and toward objects of common interest will tend toward a state of balance. Consider the following situation: Person A likes to smoke marijuana and believes its sale should be legalized. Person B is against legalization, and does not smoke at all. From the point of view of Person A, a balanced situation exists if he dislikes B. If, however, he likes B, then the situation is unbalanced. Heider sees balance as being a goal in such situations; in order to achieve it, some element must be changed. In the latter situation Person A would either have to change his mind about Person B or his attitude toward marijuana.

Another important aspect of Heider's balance theory is the idea that various feelings (which Heider calls "sentiments") within the person will tend toward homogeneity. That is, if you like someone, you are more likely to think of him as having other positive attributes (e.g., intelligent, kind, etc.).

This phenomenon is known as the *halo effect*, which makes it difficult to judge people whom you know well. Your tendency, rather than objectively to assess each of a person's attributes independently, will be to adopt a set of sentiments that are consistent with one another. (See Figure 19.1.)

Theodore Newcomb (1959) has added something to these ideas, suggesting that communication between individuals may serve the function of achieving balance. When, for example, two people A and B have different

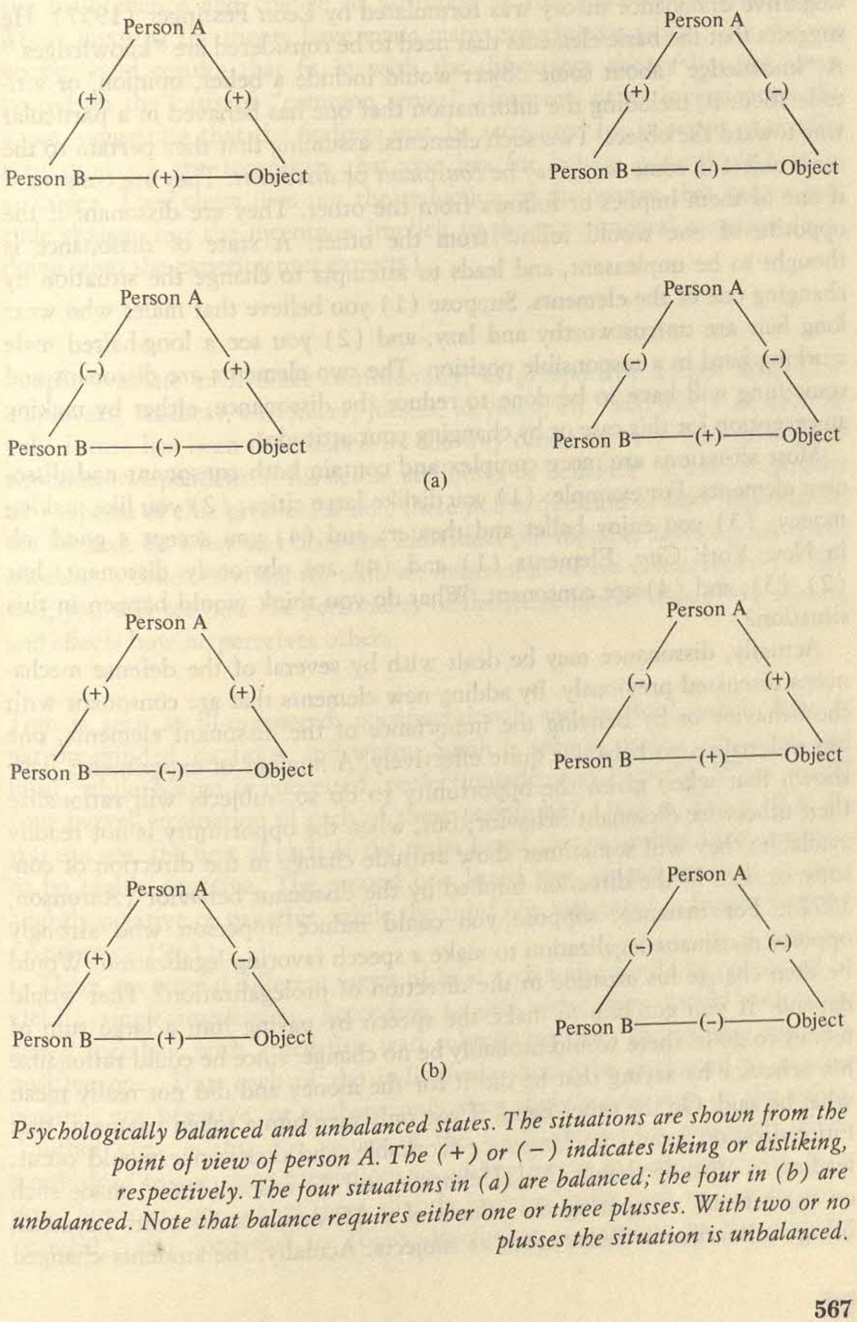


FIGURE 19.1

Psychologically balanced and unbalanced states. The situations are shown from the point of view of person A. The (+) or (−) indicates liking or disliking, respectively. The four situations in (a) are balanced; the four in (b) are unbalanced. Note that balance requires either one or three plusses. With two or no plusses the situation is unbalanced.

attitudes toward some object, then, if A and B like each other, a condition of *strain* is created, which, in turn, leads to communication. Communication tends to reduce strain, and Newcomb sees it as an instrumental response that people learn because of the reinforcing effects of this strain reduction. Thus communication between the two people mentioned, who had differing views on marijuana, but who liked each other, would tend to reduce strain. Either they would stop liking each other or one of them would change his views.

COGNITIVE DISSONANCE

Cognitive dissonance theory was formulated by Leon Festinger (1957). He suggests that the basic elements that need to be considered are "knowledges." A "knowledge" about some object would include a belief, opinion, or attitude about it, including the information that one has behaved in a particular way toward the object. Two such elements, assuming that they pertain to the same object in some way, may be *consonant* or *dissonant*. They are consonant if one of them implies or follows from the other. They are dissonant if the opposite of one would follow from the other. A state of dissonance is thought to be unpleasant, and leads to attempts to change the situation by changing one of the elements. Suppose (1) you believe that males who wear long hair are untrustworthy and lazy, and (2) you see a long-haired male working hard in a responsible position. The two elements are dissonant and something will have to be done to reduce the dissonance, either by making an exception for this case or by changing your attitude.

Most situations are more complex and contain both consonant and dissonant elements. For example: (1) you dislike large cities; (2) you like making money; (3) you enjoy ballet and theater; and (4) you accept a good job in New York City. Elements (1) and (4) are obviously dissonant, but (2), (3), and (4) are consonant. What do you think would happen in this situation?

Actually, dissonance may be dealt with by several of the defense mechanisms discussed previously. By adding new elements that are consonant with the behavior or by denying the importance of the dissonant elements, one can rationalize his behavior quite effectively. A number of experiments have shown that when given the opportunity to do so, subjects will rationalize their otherwise dissonant behavior; but, when the opportunity is not readily available, they will sometimes show attitude change in the direction of consonance, i.e., in the direction implied by the dissonant behavior (Aaronson, 1972). For instance, suppose you could induce a person who strongly opposes marijuana legalization to make a speech favoring legalization. Would he then change his attitude in the direction of prolegalization? That would depend. If you got him to make the speech by paying him a large sum of money to do it, there would probably be no change, since he could rationalize his behavior by saying that he did it for the money and did not really mean what he said. On the other hand, if you only give him a token payment, that rationalization would no longer be workable, and dissonance would occur, leading to attitude change. Nel, Helmrich, and Aaronson (1969) made such an experiment, comparing the effects of a $5 versus a 50 cents payment, using antimarijuana Texas coeds as subjects. Actually, the students changed

their attitudes only when they were paid 50 cents *and* thought their speech might influence the recipients. When they thought they were talking to people who had already made up their minds or when they received the $5 payment, they showed no attitude change themselves. In other words, the dissonance may have involved guilt at saying something that they felt might influence someone in the wrong way, although they could rationalize the guilt by "doing it for the money."

The idea of cognitive dissonance as a drive, and as a factor responsible for the maintenance and change of attitudes, is still somewhat controversial. Those favoring the theory have made many experiments which, like the one above, yield results that fit in with the dissonance theory but are unexpected on the basis of "common sense." However, other investigators disagree, suggesting that the findings may be accounted for in terms of conflict resolution via the incentives that one has for having a particular set of attitudes. They claim it is not the reduction of dissonance that causes attitude change, but the incentives implicit in the experimental situation (e.g., doing what the experimenter expects).

Perceiving and Judging Others

People evaluate each other continuously, as prospective friends and allies, employers, teachers, customers, judges, jurymen, etc., and many an individual's future has been determined by the way others *perceive* him in a given situation independent of his actual attributes or behavior. We shall consider two aspects of this problem. First, there is the question of how impressions are formed: In what way does one individual put together information about another in order to come up with an impression of his characteristics? Second, you will see how the personality of the judge himself enters the picture and affects how he perceives others.

PERCEIVING TRAITS IN OTHERS

Tom is seen as ill-mannered, unconventional, and truthful, while John is narrow-minded, cautious, and warm; Sarah is seen as mean, impulsive, and loyal, while Marge is conceited, perfectionistic, and friendly. What would your overall evaluation of each of these people be? Look at Table 19.1. As you can see, the first of each of the traits listed was judged by many subjects to be highly negative. The second one listed was judged neutral, or only slightly positive or negative, while the third one was rated as highly positive (Anderson, 1968).

There are several different views of how such traits would be combined to yield a single impression. According to one view, they would simply be *added* together, with a negative trait subtracting from the value given to a positive one. Thus each of the individuals should be evaluated as neither positive nor negative, or perhaps only very slightly one way or the other. Another view is that the values of the traits should be *averaged*, which would lead to the same predictions as adding in the present examples. Suppose, however, you added three slightly positive traits such as "persistent," "careful," and "orderly" to Tom's description. According to the additive

TABLE 19.1 *Likableness Ratings for 30 Trait Words from Anderson's List*

Word	*Rating*	*Word*	*Rating*
Sincere	*5.73*	*Unpredictable*	*2.90*
Loyal	*5.47*	*Emotional*	*2.83*
Truthful	*5.45*	*Bashful*	*2.80*
Warm	*5.22*	*Lonesome*	*2.74*
Friendly	*5.19*	*Restless*	*2.74*
Orderly	*3.99*	*Materialistic*	*2.60*
Careful	*3.90*	*Dependent*	*2.54*
Self-critical	*3.89*	*Self-conscious*	*2.49*
Serious	*3.79*	*Critical*	*2.43*
Nonconforming	*3.69*	*Impractical*	*2.13*
Persistent	*3.47*	*Ill-mannered*	*0.95*
Unconventional	*3.46*	*Narrow-minded*	*0.80*
Cautious	*3.34*	*Conceited*	*0.74*
Perfectionistic	*3.22*	*Mean*	*0.37*
Impulsive	*3.07*	*Phony*	*0.27*

NOTE: Ratings were made on a scale ranging from 0 (dislike) to 6 (like). Ratings above 3.00 are positive, below 3.00 are negative.
Source: From Anderson, 1968.

view, these three traits would erase the effect of the trait "ill-mannered," while according to the averaging view they would contribute only slightly to the impression of Tom. What do you think would happen? Research by Anderson and his colleagues tends to support the averaging model, although not all traits contribute equally to the product. Thus the overall impression is a *weighted average* (some traits carrying more weight than others) of the value of the traits.

The traits that carry more weight in determining the impression are sometimes called *central traits* (Asch, 1946). In any complex of traits one or two will be more important than the others, and may even cause a shift in the meaning of the remaining traits. Bipolar (i.e., positive on one end, negative on the other) traits such as warm-cold, and honest-dishonest are more likely to be central traits, but whether or not a given trait is central depends in a complex way on the other traits that are present. There is some evidence that traits which have good-bad connotations tend to carry much weight and, as balance theory would predict, would cause one to infer other traits which would be consonant with these central traits (i.e., recall the halo effect discussed on pp. 564–565).

In the absence of other information about individuals, people tend to judge a person in terms of his similarity to a particular group of people. This tendency is called *stereotyping* and is a quite prevalent aspect of human behavior, probably based upon some form of stimulus generalization (Chapter 7), combined with the attempt to maintain cognitive consistency. Popular stereotypes include the following: Germans are industrious; Poles are

stupid (viz. "Polish jokes,"); Jews are avaricious, etc. Stereotyping is a very important component of prejudice, as you will see later.

ATTRIBUTING BEHAVIOR TO OTHERS

Quite often in real life we are called upon to infer whether or not someone behaved in a particular way. A teacher wants to know who threw the spit-ball while her back was turned; a jury has the task of deciding whether or not a defendant is guilty. Such decisions of fact are important, particularly to the people whose futures are at stake. They are, however, quite subject to influence by a number of irrelevant factors, including the attractiveness of the accused, the similarity between the accused and the judge, and the personality of the judge.

ATTRACTIVENESS

Although according to the principles of equality and justice for all, the attractiveness of an individual should have little to do with whether or not he or she is judged as good or bad. It does appear, however, to make a big difference. In a study by Dion (1972) women were shown descriptions of several classroom disturbances, together with a picture of the child who supposedly initiated each. When the child was physically attractive, the judge was more likely to excuse the disruptive behavior as being atypical. On the other hand, when the child was pictured as unattractive, the judge was more likely to say that the bad behavior was characteristic of the child. In other words, permanent, bad traits were attributed to unattractive, but not to attractive, children.

SIMILARITY

Your attribution of particular behaviors to other people will also depend on their similarity to the way you perceive yourself. As an example of how this factor works, consider the following experiment by Herman Mitchell and Donn Byrne (1973).

The experiment used introductory psychology students as jurors whose job it was to decide on the guilt and/or punishment for a defendant accused of stealing a copy of an examination to be administered the next day. The experimenters had previously gotten a lot of information about the student jurors in regard to their attitudes about fraternities, drinking, the social aspects of college life, religious beliefs, and the American way of life. They prepared briefs about the crime, including a description of the subject, and, in particular, his attitudes about the five topics above. Each juror read a brief in which the defendant was described as having beliefs that were either in complete agreement or complete disagreement with the juror. The beliefs were, of course, irrelevant to the question of the defendant's guilt or the seriousness of the crime. When asked to judge their certainty of the defendant's guilt and to mete out punishment, jurors who scored high on a test of authoritarianism were strongly affected by similarity. That is, they were more certain that the dissimilar defendants were guilty, and they recommended a more severe punishment. Low authoritarians were less affected by similarity.

Later work suggests that *very* low authoritarians may be just as much affected by irrelevant similarities in meting out punishment when the defend-

ant, rather than being a "common man," is a symbol of authority such as a policeman. Thus, in some respects individuals either strongly authoritarian or strongly antiauthoritarian are similar in the way that they judge other people.

Interpersonal Attraction: Liking

One of the most prominent features of interpersonal behavior is the fact that a given person may be attracted to some people but not to others. People who like each other are more likely to affiliate than people who do not like each other. In this section we shall deal with some of the factors that affect liking.

PERSONAL TRAITS

As you might expect, a person is more prone to like someone whom he perceives as having positive traits. As you saw earlier, the overall likeableness of a person seems to be an average of the likeableness of his traits. However, that is not the whole picture.

Eliot Aronson (1972) asked whether a person might not be better liked if he exhibits some "flaw" in his character than if he is seen as essentially "perfect." He noted that President Kennedy's popularity *increased*, according to the Gallup Poll, immediately after the abortive Bay of Pigs Invasion in 1961. That seems strange, since, no matter how you look at it, it was a bungle, and a very serious one at that, for which Kennedy took complete responsibility. Perhaps the public prefers a leader who is only almost perfect, with one or two weaknesses.

In order to investigate this question Aronson made an experiment in which subjects rated another person on attractiveness. The one to be judged was presented in a taped interview in one of two ways.

1. Highly competent. He answered a number of difficult questions correctly, and reported that he was an honors student, an athlete, and yearbook editor in high school.
2. Mediocre. He answered only a few questions correctly, reported making average grades, and had failed as an athlete.

In addition, each of the two "interviews" either included a blunder (spilling coffee) or not, for a total of four conditions: perfect, perfect with blunder, mediocre, and mediocre with blunder.

The results are interesting and instructive. They indicate that Superior Persons can get away with blunders quite easily, for the most attractive ratings came in the "perfect with blunder" condition. On the other hand, Mediocre Persons had better be more careful, because the *lowest* ratings were obtained in the "mediocre with blunder" condition. It perhaps seems unfair, but the blunder enhanced the Superior Person's attractiveness, while the same blunder detracted from the rating of the Mediocre Person (Aronson, 1972).

SIMILARITY IN ATTITUDES

Balance theory would predict that individuals who share attitudes about various objects of interest would be more likely to like each other than individuals whose attitudes are dissimilar. Furthermore, according to New-

comb's ideas about strain reduction, the more that given individuals interact and communicate, the stronger the relationship between attitude similarity and liking. Newcomb (1961) investigated this idea in an experimental living situation, where subjects agreed to live together for a school term. As the term progressed, the expected relationship between attitude similarity and attraction did develop so that at the end the strongest friendships were between those people who had the most attitudes in common.

PROXIMITY

We tend to affiliate with and to like those who are near us. In other words, physical distance places a very real and obvious limitation on our friendship choices. W. H. Whyte (1956) studied a community of relatively homogeneous homes and found that the pattern of invitations to parties was quite strongly related to proximity of housing. People living near each other tended to go to the same parties. The exceptions were parties for specialized activities such as playing bridge and preparing gourmet foods; participants in these activities tended to be spread over the community.

An earlier study of friendship patterns in an apartment building showed the same thing, though more dramatically. As you can see in Figure 19.2, people tended to like those people in the apartments nearest them, and the probability of being friends with someone dropped quite regularly with the increase in physical distance between apartment doors (Festinger, Schachter, & Back, 1950).

ATTRACTIVENESS

There are many sayings, such as "Beauty is only skin deep," which suggest that physical attractiveness is (or, better, should be) unimportant as a determinant of liking. On the other hand, what research has been done suggests that physical attraction is in fact one of the most important determinants of one person's response to another person. You have already seen how this variable works in affecting the judgments about peoples' behavior. In another experiment Elaine Walster et al. (1966) showed that it also plays a major role in liking. She randomly matched male-female pairs (college students) who had agreed to participate in a "computerized dating project." Various ratings were made on the students, including several personality traits and physical attractiveness. The question was which of the many possible predictors would predict liking, defined simply by whether or not the pair agreed to have another date. The answer was quite clear: The only determinant of making a second date was physical attractiveness. Similar results have been found with preschool children. Those who are physically attractive are liked better than those who are not (Dion & Berscheid, reported in Aronson, 1972). Whether the same patterns would be found in a heterogeneous population (e.g., the armed services or a large heterogeneous high school) remains to be seen.

REWARDS, COSTS, AND INGRATIATION

By and large, you are more likely to like someone who does something nice for you "out of the goodness of his own heart" than someone who would not do you a favor, and it is hard to like someone who is always demanding,

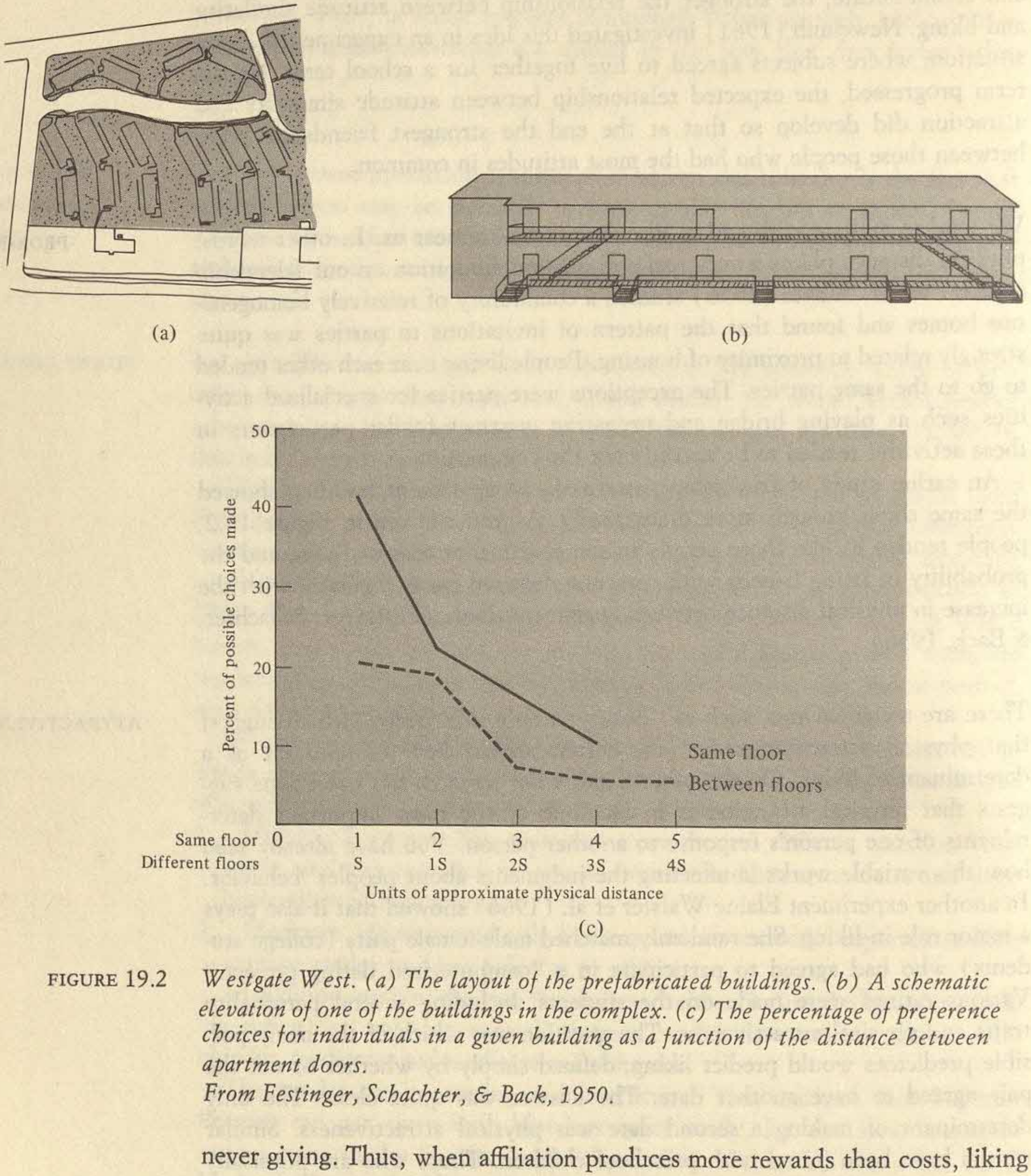


FIGURE 19.2 *Westgate West. (a) The layout of the prefabricated buildings. (b) A schematic elevation of one of the buildings in the complex. (c) The percentage of preference choices for individuals in a given building as a function of the distance between apartment doors.*
From Festinger, Schachter, & Back, 1950.

never giving. Thus, when affiliation produces more rewards than costs, liking occurs.

However, that is not the whole picture. In several experiments it was found that the *change* in rewardingness is more important than the absolute level. For example, if over a series of encounters you find that a given individual begins to make more and more positive statements about you (seems to like you more), then your liking for him will be greater than if he had been positive all along. The *gain* in the evaluation seems to be the main element here. Likewise, converts are often more highly valued than the old faithful ones in religious groups. The reward seems to be in having had an

impact on that person, having won against the odds, or something like that (Aronson, 1972).

There is at least one serious exception to these ideas, which should give you pause before trying to implement them. Most of us do not like to be manipulated, and if we suspect that someone is doing us favors or apparently liking us in order to gain something from us, the reaction is more likely to be negative. *Ingratiation* is the name given to the manipulative behavior, and it has been studied quite extensively. E. E. Jones (1964), for example, reports the following experiment. He arranged for a female co-worker to watch a subject (a female student) being interviewed, and then to evaluate her under one of two conditions. In one condition (ingratiation) the evaluator was given an ulterior motive—the subject was told that she (the evaluator) wanted to get the subject to participate in her own experiment later. In the other condition there was no ulterior motive. The evaluation heard by the subject was either flattering, unflattering, or neutral. Then the subjects were asked to indicate how much they liked the evaluator. Although flattery produced more liking than the negative evaluation, the presence of the ulterior motive reduced sharply the amount of liking reported by the subjects. In other words, if you are going to try to win friends by flattery, you should not give the impression that you are out for something else (favors, etc.) as well, or the effort may backfire.

Attitude Formation and Maintenance

Why are attitudes developed, and how are they maintained over long periods of time? The answer is not simple, since a large number of factors are involved. Attitudes are acquired through conditioning and instrumental learning. They are maintained partly because of their incentive value, and apparently also because of the operation of cognitive consistency motivation.

CONDITIONING

Advertising displays often attempt to produce positive attitudes toward the product by means of emotional conditioning. Because of the principle of contiguity, whereby stimuli that appear together become associated, you are supposed to develop a positive attitude toward Salems because they are shown together with mountain streams, green meadows, and beautiful girls. A black person watching white policemen and police dogs attack peaceful marchers would most likely, through contiguity, come to associate the resulting negative emotions with white policemen. In both cases the emotion would come to be evoked later in the presence of the conditioned stimulus (Salems or white policemen) by itself.

INSTRUMENTAL LEARNING

Attitudes are developed partly because people are rewarded by other people for having particular attitudes. Attitudes are like currency, in that they can be used to win and keep friends and other positive goals. Children, rewarded for adopting the attitudes of their parents, may be placed in quite a conflict when the time comes to change, perhaps in order to be more like one's friends.

Indirect reinforcement of modeling behavior may also be involved. One's

attitude toward the role of women in society is partly determined by the sex-role behaviors that one has himself learned. Attitudes toward members of minority groups will partly depend on whether one has, say, learned to react aggressively toward them through modeling the behavior of other people. As you will see presently, behaving in a particular way may in some cases create a pressure to adopt an attitude congruent with that behavior.

FACTUAL LEARNING

Many attitude-changing campaigns have operated on the assumption that attitudes depend upon knowing a set of facts about the object of the attitude. The Surgeon General's campaign against cigarette smoking, for example, is factually oriented. Newspaper pictures of a dead heroin addict or one recently arrested for larceny provide factual information relevant to one's attitude toward hard drugs.

Although factual information may in many cases be responsible for attitude development and change, its role is not as important as it should be, particularly when the facts run contrary to strongly held beliefs or desires. It is usually too easy to rationalize, make exceptions, or simply to deny the facts.

COGNITIVE CONSISTENCY

You may wonder why factual information is relatively ineffective in promoting attitude development and change. One answer seems to be that attitudes and beliefs must exist in a context of other attitudes and beliefs and people tend to try to maintain consistency among them. Incorporation of a new attitude into one's system of beliefs will be difficult unless the new attitude is consonant with the old ones. You have already seen something of how this factor operates in the earlier discussion of cognitive dissonance.

Persuasion

In order to persuade someone to do or believe something that is opposed to what he is presently doing or believing, you must change his attitudes. Persuasion is an everyday occurrence, and persuasive skills are envied by almost everyone. Although social psychologists have studied the process for some time, it is still not very well understood; perhaps fortunately, no one yet knows enough to be able to deal with people as though they were putty.

The persuasion situation involves a *source*, who aims a *communication* at a *target* in a particular *context*, with the goal of causing a change in the target. Each of these factors is important in determining the effectiveness of the effort.

THE SOURCE

The responses "Oh yeah?" or "Who says so?" are quite common. If a message is seen as coming from someone with a great deal of prestige or expertise, then it is more likely to be effective. In one experiment college students evaluated a poem they had just read, after which an attempt was made to get them to change their opinion by reading them a message evaluating the poem. The message was effective when it was thought to be written by T. S. Eliot, but ineffective when it was attributed to another college student (Aronson, Turner, & Carlsmith, 1963).

Sources who appear to be arguing against their own self-interest are more

likely to be effective than ones who might have a stake in convincing you. A member of the Mafia is more likely than a "law-and-order" congressional candidate to convince you that police are too lenient on criminals, and a prominent doctor or lawyer would be more likely to convince you to favor legalization of marijuana than would a local "dealer."

THE COMMUNICATION

Some messages are more convincing than others. Suppose A wants to convince B that marijuana should be legalized. What should he say? The answer depends on B's position. If B is strongly opposed, and A is just an average guy, then A is well advised to avoid an extreme argument. In general, unless the source is high in prestige and credibility, then a communication that is only moderately discrepant from the target's attitude will be more effective than one that is highly discrepant. A highly prestigious and credible source, however, can get away with much more discrepancy. In the example just given, A, the president of the American Medical Association, might be able to convince B that marijuana legalization was good if he made an extremely favorable statement. On the other hand, the average "head" would have little effect with an extremely favorable argument but might make some headway with a mildly favorable argument.

Another strategy question concerns whether one should present both sides of the argument, or only one side. A number of studies have examined this question, and, while there are the usual exceptions, it would appear that reasonably intelligent, well-informed people will be more influenced by a two-sided argument (Friedman, Carlsmith, & Sears, 1970).

THE TARGET

Some targets are earsier to persuade than others. Sex, self-esteem, and other personality variables all make a difference. According to Friedman et al. (1970) women are easier to persuade and change their attitudes more than men. Apparently, this difference comes about because of the learning of social roles, since the differences do not appear in young children but do show up in high school students. The higher a person's self-esteem, the less persuadable he will be.

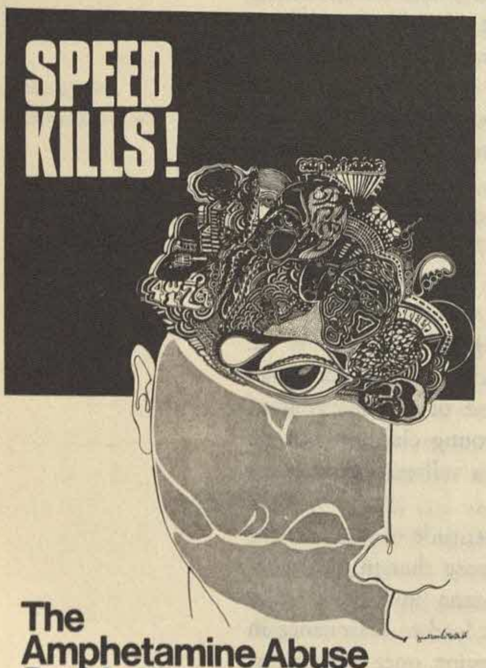
The behavior of the target can play a major role in attitude change, as was implied in the discussion of cognitive dissonance. Suppose that in our hypothetical example A were able to get B to smoke marijuana "just once." The fact of having engaged in such behavior would perhaps lead to dissonance in B between his attitude and his behavior. Since the behavior, once it happens, can hardly be changed, a reduction in dissonance might take place through a change in attitude on B's part.

THE EMOTIONAL CONTEXT

The emotional context in which a message is presented may be quite important. Many messages are presented in a context of fear, such as "hell-fire" sermons and warnings not to smoke (Figure 19.3). How effective are they? Actually, the literature is somewhat conflictual. An earlier study (Janis & Feshbach, 1953) indicated that a message ("Brush your teeth three times a day") was more effective when fear was minimized than when the message was designed to provoke fear (e.g., close-up pictures of gum disease, decayed

7 lbs., 6 oz. and a victim of syphilis

Since 1900 syphilis alone has killed 4 million Americans. 3 million of those victims were babies who never heard of the word sex. What makes this even more tragic is the fact that V.D. *can be prevented.*



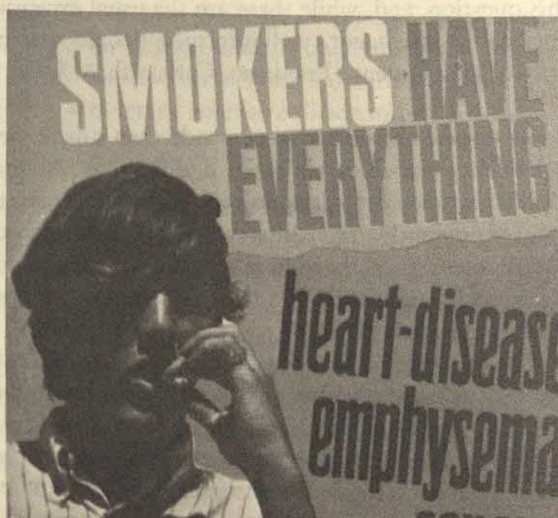


FIGURE 19.3 *Some attempts to persuade with the use of fear. Courtesy of American Social Health Association, Studio Press, Inc. and Youngs Drug Products Corp.*

teeth, etc.). However, another study (Dabbs & Leventhal, 1966) found that the message "Get a tetanus shot" was more effective in a highly fearful context in which all the gory details of the disease were pointed out. The main difference seems to have been whether or not a positive action was readily available to the subject. It was quite easy to go down the hall to the student health service to get the shot, while making a commitment to brush your teeth three times a day is considerably more bothersome.

After reviewing a number of studies on this question Friedman et al. (1970) conclude that given the right circumstances, moderate fear is a very effective component of persuasive communications. However, if the fear is too intense, then it has been suggested that the subject will become defensive and "turn off" the message (Janis, 1967).

RESISTANCE TO PERSUASION

The publicity given "brainwashing" after the Korean conflict led to great concern that the Chinese Communists had techniques for persuading people that were highly effective, and that constituted a threat to American citizens. Actually, as Elms (1972) has cogently pointed out, the techniques employed in "brainwashing" were primarily based on the notion that attitudes serve as currency. It would appear that their use on a mass scale would be impossible, and even on a small scale they are highly inefficient. Basically, the fact is that most attitudes are quite resistant to change, even by "expert" social scientists.

Nevertheless, there has been some consideration of how one's resistance to persuasion might be increased. One approach was to view a persuasive communication as something akin to a germ, the body's task being to protect itself against intrusion. Perhaps, you might think, a germ-free environment would be helpful. Many parents assume this task and try to shield their children from "improper" attitudes. The method, however, is about as feasible and effective as its counterpart in medicine—we learned long ago that *inoculation* is a much better approach against disease. This approach was tried for attitudes by McGuire (1961), with some success.

McGuire found that presenting subjects with mild counterarguments against such health maxims as "Brush your teeth three times a day," and "Get a medical checkup once a year" made them more resistant to strong counterarguments presented later, in much the same way that weakened or dead germs will make you immune to later attack by the live organism (see Figure 19.4). McGuire called the process of strengthening one's resistance inoculation.

One reason why inoculation works is that the procedure gives the subject forewarning of an impending attack, and thus provides time for working up his own counterarguments. In one study a message intending to persuade teenagers that they should not be allowed to drive was presented either with or without forewarning. The subjects taken by surprise were more strongly influenced by the message than those who were warned (Freedman & Sears, 1965). Whether or not other processes are brought into play in the inoculation situation is still under debate, and the answer is not yet clear.

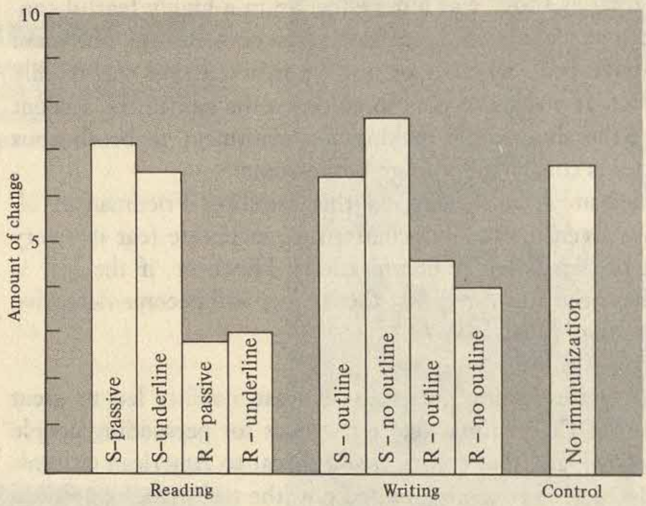


FIGURE 19.4 *The effects of immunization of various kinds on persuasion. The vertical axis indicates the amount of change in the subjects' attitudes after being subjected to strong arguments counter to their original position. In the various immunization conditions the subjects either read or wrote mild arguments that were supportive (s) or which refuted (r) their positions. They read passively or actively (by underlining key sentences); or they wrote arguments with or without the benefit of an outline provided by the experimenter. Note that the greatest resistance to persuasion occurred when the arguments were mildly contrary to the original position (R), and that reading was more effective than writing.*
From McGuire & Papageorgis, 1961.

Behavior in Social Situations

In the previous section you encountered some of the cognitive factors that affect one's behavior in social situations. Now we shall turn to an examination of some kinds of social behavior itself. Although there are many ways in which social behavior may be categorized, we shall consider four types of social behavior that have received a great deal of attention by social psychologists: helping or altruistic behavior; compliance with and conformity to norms and expectations; competing and cooperating with others; and behavior in organized group situations, including the phenomenon of group leadership.

Helping and Altruism

For a long time it was thought that the natural state of things was for humans to help one another. You see someone in trouble and you help him as best you can. This is a part of the Judaeo-Christian ethic ingrained in our behavioral patterns; and the very existence of society depends upon this basic helping attitude.

However, recently, psychologists and other social scientists as well as the public at large have been shocked by these events and others:

> Kitty Genovese was raped, stabbed, and beaten to death over the course of a half hour at 3 A.M. in Kew Gardens in New York City. Her attack and death was watched by 38 of her neighbors, looking from their apartment windows. No one helped or even called the police.
>
> A 17-year-old boy was stabbed in a Manhattan subway in the presence of 11 other riders. The attackers left unharmed, and the boy bled to death. No one helped.
>
> An Atlanta, Georgia, engineer was accousted by a pickpocket while waiting for a bus in plain daylight, in the presence of at least 10 other people. He grabbed back his wallet, and the pickpocket stabbed him. No one helped. The man finally got on a bus and went to the hospital by himself.

What can account for this depressing situation? Although people certainly do help in many situations that go unreported, how could it be that *no one* in these three emergencies would help?

Bibb Latane and John M. Darley (1970) undertook a series of experiments to find out some of the conditions under which people would and would not offer help. First of all, they noted that a surprisingly high, 75 to 85, percent of New Yorkers were helpful when asked for directions, the time of day, or for change for a quarter. When given the right cover story ("My wallet's been stolen" or "I need to make a phone call"), they would even give a stranger a dime. They would also offer to correct some incorrect directions given by a confederate to another associate on the subway (e.g., on a southbound train, confederate 1 asks two people, one of whom is confederate 2, "Is this train going north?" Confederate 2 answers "Yes"). Half of the people tested in this way would correct the false directions, and almost all of them would correct them if the question had initially been directed to the subject himself, with the answer by confederate 2 simply being interjected. However, considerably fewer people would help if they were led to believe that the false directions were given by someone who would be likely to make trouble if he were contradicted. Apparently, many people would simply rather not get involved.

These observations indicate that even New Yorkers are not completely cold and calloused to human problems. So why did they not help in the real emergency situations? Latane and Darley explored some possible answers by contriving some emergency situations.

DIFFUSION OF RESPONSIBILITY

In one experiment they had subjects wait in a room, and then they pumped smoke through the air conditioning ducts, noting the conditions under which the subject would report the smoke. Of the subjects who waited alone, half of them reported the smoke to someone very quickly, within 2 minutes, and 75 percent had reported it by 4 minutes. On the other hand, when two confederates of the experimenter were waiting with the subject (neither of

whom did anything in response to the smoke), only 10 percent reported it. A similar effect occurred when the three waiting subjects were all naïve, i.e., no confederate was present. Only one of 24 subjects reported within 4 minutes, and only three reported at all during the experiment. These results indicate that the *presence of someone else tends to inhibit one's responsiveness to someone in need.*

This inhibitory effect was seen in several other well-contrived examples. In one of them a secretary gave the impression of having just had a filing cabinet fall on her. Of subjects who waited alone, 70 percent offered to help, while only 7 percent offered when they were with a passive confederate. When they were with a naïve stranger, 40 percent helped. When the subjects were friends, they were more likely to help but still less likely than when alone.

In order to eliminate the laboratory atmosphere, Latane and Darley simulated the theft of a case of beer in a discount beer store, asking themselves whether the customers would report the theft. It was staged when a given customer was waiting to be served alone or in the presence of another customer. Again, when another customer was present, the subjects would not report the theft.

Why should the presence of someone else inhibit one's own responsiveness to an emergency situation? The answer probably lies in the "diffusion of responsibility" that occurs when you are with someone else and an emergency happens. Who is responsible for helping—you or your companion? The answer is not nearly as clear as when you are by yourself. Then, too, the longer you wait, the more difficult it is to respond. After all, you should have reported the smoke as soon as you saw it. If you finally do report it, you have to justify why you did not report it sooner. Thus the indecision produced a delay, which in turn produced a further delay.

It is not likely that such explanations will work for bystander inaction in the real incidents mentioned earlier. The bystanders, when interviewed, said they did not want to get involved. In the Atlanta case one person reported that she could not afford to spend the time to go down to the police station, be a witness, etc., so she offered no help. Thus, as with most issues, we still have a lot of questions to answer. Since it is rather hard to simulate stabbings, etc., it is hard to say how far the findings with simulated emergencies can go in helping us understand behavior in real ones.

Aronson (1972) offers an interesting epilogue to the studies by Latane and Darley. He recounts an incident that he experienced while camping at Yosemite National Park. He was awakened by a man's voice crying out, and, when he went to see if help was needed, was surprised to find that dozens of other campers had done the same thing. Everybody went to help. Why should this be, when all the evidence would suggest that no one would respond? He speculates that the relationship of "fellow camper" was sufficient to overcome any inhibitory effects of knowledge of the presence of other people. Helping others "in the wilds" is possibly the norm, and perhaps the inactivity on the part of bystanders in the other situations may also reflect their

conformity to existing social norms which include such things as not "losing your cool," or not revealing strong emotions in public.

Compliance and Conformity

Compliance is the tendency to give in and do something under some pressure. A special case of compliance is obedience to commands, as is expected of children and military personnel. Conformity is a broader term, referring to the tendency to behave in accordance with the expectations of others and with societal norms, and to behave in the way that others do. Both terms imply that the person surrender autonomy in his behavior, adjusting it more in accordance with what other people do, feel, say, and think. Conformity and compliance are necessary components of any organized society, and society and governments could not exist without them.

In this section we shall deal with several aspects of compliance and conformity. First, you will see some of the extremes to which people will go in order to comply or conform. Second, some conditions affecting the amount of such behavior will be discussed, and, finally, you will see that it does not always occur. People sometimes react to attempts to make them conform by doing the opposite.

EXTREMES OF CONFORMITY AND COMPLIANCE

A number of years ago, Solomon Asch (1951) surprised a lot of people, including himself, by showing that some college student subjects would conform to the opinions of others, even when it involved agreeing with opinions that were directly contradicted by their own sensory experience. The subjects judged the relative length of lines (see Figure 19.5) in the presence of confederates numbering from 2 to 16. It was arranged that the subject always judged last, preceded by the confederates. On some of the trials, the confederates made unanimous incorrect judgments. Since the unanimous judgment was obviously incorrect, the subject was put under a great deal of pressure. Would he judge according to his senses, or according to the majority? Surprisingly, when there was a majority of three or more, about one third of the subjects would go along with the group's judgment. This finding has been replicated numerous times, and a number of the factors affecting the amount of conformity have been examined. Some of them will be discussed a little later. At present, you should simply be aware that it is possible to elicit such an extreme amount of conformity in the laboratory.

An equally surprising and shocking degree of obedience has been elicited in a laboratory situation by Stanley Milgram (1963). Subjects, who were recruited through newspaper advertisements, included a good cross section of men from New Haven, Connecticut. They were immediately paid $4.50 for coming to the experiment, and were told that they could drop out at any time and still keep the money. The experiment, they were told, was in learning. Supposedly arriving in pairs, one of them (the subject) was designated as "teacher," while the other (a confederate) was designated as "learner." The learner was to attempt to learn some lists of paired associates, and the teacher was to deliver increasingly severe shocks for incorrect responses. The shocks (which, of course, were never actually administered to

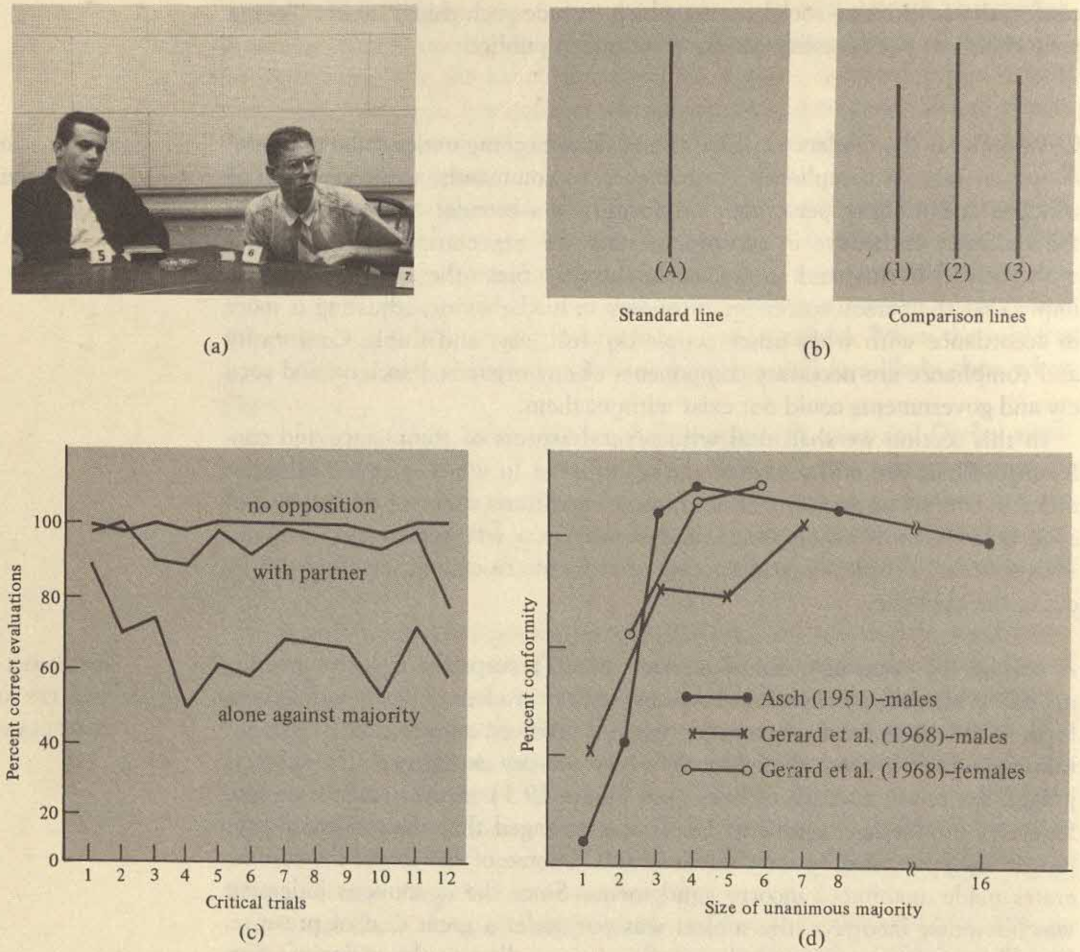


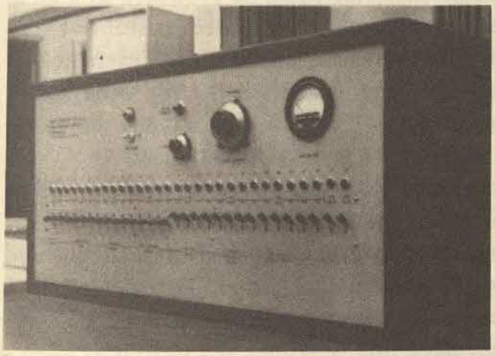
FIGURE 19.5 *Asch's conformity experiment. (a) The situation. Subject No. 6, the naïve subject, is about to judge. (b) The stimuli. The subject's task is to say which of the three lines on the right is most like the one on the left. (c) Results. Note that the subject was almost always correct when there was no one making contradictory judgments. He was also mostly correct when there was one other person who was also naïve ("with partner"). When he was alone, however, his correct judgments decreased, since he tended to conform to the erroneous judgments of the majority. (d) The results of several studies varying group size. Note that the maximum amount of conformity is found with a group of about 4.*
(a), (b), and (c) from Asch, 1955; (d) from Asch (1951) and Gerard et al. (1968); photograph in (a) by William Vandivert.

the learner) were "delivered" by machine with switches graduated in 15-volt steps from 15 to 450 volts. The upper levels bore such labels as "Extreme intensity shock," "Danger: Severe Shock," and "XXX." During the intermediate levels of shock the learner played a tape recording of various complaints, including screams, reminders that he had a heart condition, pounding on the wall, and shouts to let him out because he had had enough. Then, with the

higher levels, there was only silence. The experimenter, meanwhile, countered the efforts of the "teacher" to quit with such phrases as "The experiment must go on. . . . You must continue." He assured the "teacher" that he would take full responsibility for anything that happened.

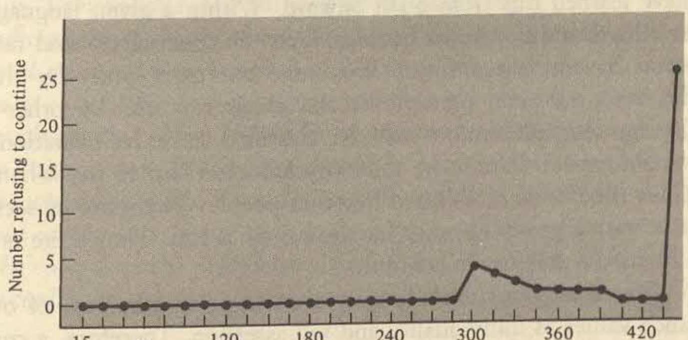
What would you do in such a situation? If you are like over half of Milgram's subjects, you would go on with the experiment, and "shock" the poor "learner" until instructed to stop (Figure 19.6). Although continuing to obey, however, the "teachers" showed obvious signs of nervousness and discomfort. Nevertheless, they could not bring themselves to disobey the experimenter and quit.

A number of factors seemed to affect the extent of the "teacher's" obedience (how strong a shock he would administer before quitting the experiment). In later studies the "learner" was placed in the same room as



(a)

(b)



(c)

FIGURE 19.6

Milgram's experiment on obedience. (a) The "shock generator" operated by the "teacher." The switches on the lower row are graduated in 15-volt steps from 15 to 450 volts. (b) The "learner" is being prepared for the experiment. Electrodes are being placed on his arms. (c) The data. The points indicate the number of subjects going on in the experiment past the shock level indicated. A few refused to go on after 300 volts, but of the 40 subjects, 26 continued on until the end. (a), (b) from the film Obedience *by Stanley Milgram; (c) from Milgram (1965).*

the "teacher," in the same room but looking the other way, or near the teacher. In general, the closer the teacher and the learner were to each other, the less likely was the teacher to continue to shock him until the end. However, some "teachers" were very persistent. In one condition the learner, in order to be shocked, had to place his arm on a shock plate voluntarily. Some of the teachers, sitting right next to the learner, actually wrestled with the learner in order to force his arm down to the shock plate in order to punish him for his mistakes.

The personality of the teacher also seems to be important. Elms (1972), who participated in some of the studies, indicated that subjects who scored high on the *F* scale for authoritarianism were more obedient than low-scoring subjects (see pp. 485 and 571).

Now you have seen two extreme cases, one involving conformity and the other involving compliance. That such behavior could be produced in a laboratory situation amazed many people at the time, and, indeed, is still not very well understood. On the other hand, history shows us that such extremes do actually occur in real life, the most shocking example being the behavior of the German police in carrying out Hitler's order to exterminate the Jews.

WHY DO PEOPLE CONFORM AND OBEY?

As indicated earlier, the two phenomena are really different, and the difference shows up clearly in examinations of the variables affecting them.

Conformity behavior has been subjected to a great deal of research, and has been shown to be affected by many different factors. (For a more thorough recent discussion of some of these factors, see Freedman et al. (1970). This discussion will be considerably more limited.)

First of all, conformity in the Asch-type of situation probably arises from the fact that we are quite dependent upon other people for *information*. We have learned this from birth onward. Within a given language community it is hard to differentiate between facts "in themselves" and facts "as agreed upon by the community." We judge our own sanity by the congruence between our own perceptions and those reported by other people. (An incongruent perception may be classified as a hallucination.) Thus you would expect there to be some psychological cost to pay when one deviates from the norms established by other people: The sense of security in being one with a group of other human beings is lost. Thus there is in any group situation a pressure to conform.

Pressures to resist conformity are also present because of our learning of such values as individuality and self-assertion. Therefore, a conformity situation like the one Asch used is in actuality a conflict situation, the resolution of which will depend on the relative strengths of the two pressures above. These pressures, in turn, are influenced by a large number of factors.

Group size affects conformity. As you saw in Figure 19.5, the tendency is for larger groups to produce more conformity. Within a given group, however, the presence of even one dissenting member reduced conformity to a much lower value—about 25 percent of that obtained with a unanimous group.

Ethical Issues in Psychological Experimentation

A lot of psychological research is done with human subjects who volunteer to participate in experiments. Less often, the subject volunteers are paid for participation. Often the participation is quasi-compulsory, in that students in Introductory Psychology classes are required either to participate in a certain number of experiments or do some other extra work such as writing a term paper.

Sometimes, it could be argued, experiments have the potential for doing harm to the unknowing subjects. Sometimes subjects are given electrical shock or other painful stimulation, and sometimes they are asked to reveal intimate information about themselves. Sometimes, as in the case of the Milgram study on obedience discussed in this chapter, they are exposed to aspects of themselves that, you might argue, should best be left under cover. Quite often, even in less extreme situations, subject volunteers are deceived by the experimenter or his confederates. There is a good reason for this deception, in that it is hard to get people to act naturally if they understand exactly what the experimenter is looking for, and many experiments simply could not be done without deception.

The American Psychological Association has for some time been concerned with ethical issues in experimentation with human subjects and has recently promulgated a revised set of ethical standards that APA members are expected to honor. They include such features as the following:

1. Informed consent. *Subjects should be given enough information about the experimental procedures to ensure that they can make an informed, intelligent decision as to whether or not to participate. In other words, if electrical shock is involved, the subject should be so informed in advance.*

2. Freedom to drop out. *The subject should be ensured that he can drop out at any time without penalty. From the experimenter's point of view a lot of dropping out can be disastrous, since quite often a subject's data are not useful unless he completes the experiment. Recall that Milgram told his subjects that they could quit any time they wished and could still keep the $4.50 pay.*

3. Debriefing. *The subject should be told what the experiment was about. This is particularly true in the case of compulsory "volunteers" from Introductory Psychology, since it is argued that the participation experience should also be an educational experience for the subject.*

4. Follow-up. *The experimenter should assure himself that his subject has not been harmed by the experience. In most cases this step is not necessary, since the large majority of psychological experiments could in no way be considered harmful. However, for example, in the case of the Milgram study,*

there is the possibility that subjects would be disturbed by what they did to the "learner."

5\. Assurance of confidentiality. *When a subject discloses something about himself to the experimenter, whether verbally, by taking a paper-and-pencil test, or simply responding to the experimental situation, the experimenter should take steps to assure that the subject's name is not identified with the record of his performance. Again, in most cases there is no problem, since much of the psychological data from experiments is not of the sort that anyone would feel sensitive about. However, in some cases, for example, when personality tests are involved, or when the subject is expected to tell details of his life that might be considered intimate, confidentiality must be respected.*

When deception is involved, the experimenter is expected to have carefully weighed the potential benefit of the research findings against the demands placed on the subject. In other words, he is expected to have satisfactorily answered the question "Is deception necessary?" and "Is it worth it?" Obviously, there are very few ambiguous cases, since intelligent, informed people may differ honestly as to the answers to those questions.

Consider again the Milgram experiment, which, as you might imagine, has produced no small amount of controversy in regard to the ethical issues. Milgram induced his subjects to demonstrate to the world that they would, if someone else took responsibility for their actions, administer lethal shocks to their "learner," even when it appeared that he had a heart condition, was in extreme pain, or was unconscious. Now, you may ask, what did we learn about human behavior that may have made that experiment worthwhile? First of all, aside from demonstrating that such obedience was possible even in middle-class America, Milgram showed that the extent of obedience was influenced by factors such as proximity to the subject. This fact should make it possible to control somewhat the potentiality for brutality on the part of people in authority when and if such situations should arise.

More importantly, however, the findings make it clear that obedience to such commands, when issued with only the slightest whiff of institutional authority, is a part of the repertoire of behaviors of ordinary American citizens. Given the proper political atmosphere, one wonders how different America would be from, say, Nazi Germany. It seems eminently worthwhile to have found this out.

Conformity depends upon *sex,* and is greater in females than in males. This is a rather consistent finding over all of the studies in which both sexes were tested.

Conformity is more likely to occur when a subject feels *uncertain* about the material to be judged. On the other hand, if he considers himself an expert on the topic in question, he will be less likely to conform to the group. For example, Coleman, Blake, and Mouton (1958) gave subjects a

number of questions to answer in a conformity situation, and found that the amount of conformity was correlated with the difficulty of the question. Easy questions produced less conformity than difficult questions. There is obviously much more to the matter than that, however, since Asch's experiment involved very easy discriminations.

In other group situations, conformity has been found to depend upon the extent to which the individual *values the group,* wants to belong to it, and feels secure in his status within the group. High status individuals will tend to conform less than those of low and moderate status, since they are more secure.

Why, and under what conditions will someone comply with a request to do something he might not otherwise do? Milgram, you will recall, showed that less obedience occurred when his teachers and learners were close to one another. Removing the victim from view, or making him different or distinct in some way, will make it more likely that one will obey an order to hurt the victim. An effective way to train troops to get over their hesitance at killing is to dehumanize the enemy in some way, so that they are seen as distinct from oneself, and not deserving the slightest amount of humane treatment. Also, as you saw in Chapter 13, aggression against others is stronger under conditions of anonymity.

For milder forms of compliance, it has been found that if a person can be induced to comply in a very small way, then it is more likely that he will comply in a larger way later. This is called "getting one's foot in the door." Freedman and Fraser (1966), for example, asked housewives to sign a petition in favor of safe driving. Then, a few weeks later, the same housewives were approached by different experimenters, who asked them to put an ugly sign in their yard advocating safe driving. Over half of them agreed, whereas less than 20 percent of another group of housewives, who had not been asked previously to sign the petition, agreed to do so.

You can also get a person to comply if you can make him feel *guilty* about something. Various studies have shown that making subjects feel that they have (1) shocked other subjects, (2) broken expensive equipment, or (3) lied, will make them more likely to comply to later requests, such as to make a number of telephone calls for a good cause.

REACTANCE

There are some circumstances under which people do not conform or comply. Rather, they sense the attempt of someone to take away some of their freedom of action and react to this attempt by doing the opposite of what is expected. Reactance, the phenomenon so-named by Brehm (1966), has been demonstrated in a number of studies. In one case two subjects had to choose which of two approximately equivalent problems to work on. Each subject was given a note, supposedly from the other subject, saying one of two things: "I choose problem A," or "I think we should both do problem A." Of the subjects getting the first note, 70 percent complied, i.e., chose problem A. However, only 40 percent chose A in the second condition. They reacted to the attempt to manipulate their decision by choosing the opposite (Brehm & Cole, 1966).

To summarize, conformity, compliance, and reactance all involve the conflict between an individual's autonomy and its loss through group pressures, commands, requests, and other manipulations. As a sphere of knowledge it gets at the heart of the processes whereby social order and organization are established and maintained. On the other hand, a practical understanding of these processes can, potentially, bring a great deal of power into the hands of the knower. Although some use has been made of the techniques of persuasion, particularly in advertising, the methods are not, in and of themselves, all that effective. Whether or not there will eventually be abuses of this power, and how seriously we shall consider them, remains to be seen. You should be aware of the potential problem.

Competition and Cooperation

We are taught from birth that we should cooperate with other people, share our things, etc. We are also taught that winning is better than losing, we should make better grades than our friend next door, and we learn something about the art of one-upmanship in arguments. Competition and cooperation are two basic, usually opposite, orientations toward other people, and we learn them both.

GAME PLAYING

Suppose you were playing a game in which you could either cooperate with someone else or compete with him and you knew that the outcome would be the same. Which would you do? A number of experiments have been performed with *nonzero-sum games* (games in which there is no limit on the amount that can be won; my win is not your loss, and vice versa). In such games subjects usually have the option either of competing or cooperating. Cooperating usually operates to the advantage of both. Deutsch and Krauss (1960) performed such an experiment using the layout described in Figure 19.7. The idea is to get from a starting point to a destination as quickly as possible. Two roads are possible, one of which is shared with the other player, but only one can use it at a time. The other one is not shared but is much longer. The optimal way to play would be to take turns at the common road. However, Deutsch and Krauss' subjects preferred to compete for the common road and usually wound up facing each other in the middle, with one player having to back up. Thus, while they were not told to compete for points, they behaved as though they were.

Another game in which competition and cooperation have been investigated is the *prisoner's dilemma game*. The prototype is as follows: Two suspects are held in separate rooms in the police department. The prosecutor thinks one of them committed a crime. He tells them that (1) if neither of them confesses, he can get them both convicted for a minor crime with a sentence of, say, 1 year; (2) if one of them confesses and the other does not, the one who confesses will get off free, while the other one will get 15 years (the maximum punishment); and (3) if both of them confess, they will both get 10 years. What is the best course of action for them? Obviously, it is for neither of them to confess, and each take the 1-year sentence. That response is, you might say, cooperative, where each one trusts the

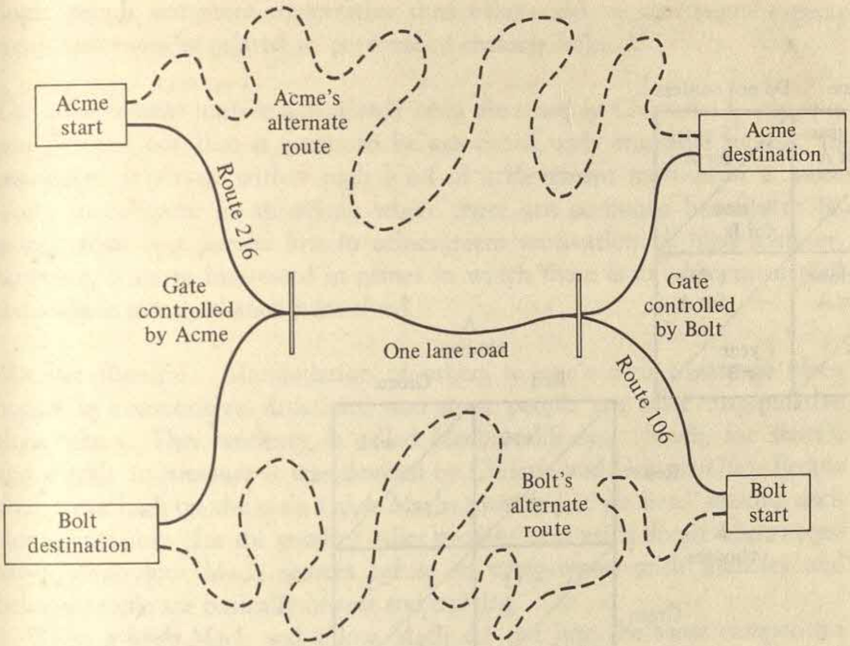


FIGURE 19.7 *The game used for studying competition and cooperation by Deutsch and Krauss. Players operated either an "Acme" or a "Bolt" trucking company truck from their respective start to the destination, as indicated. The short path required a common route over a one-lane road, but the long path could be taken without encountering the other truck.*

Deutsch & Krauss, 1960.

other not to confess. If one of them breaks the faith and confesses, he will get off and his colleague will get the maximum penalty. So the choice is between cooperating and taking a small punishment, or taking a larger risk at the expense of the other person.

Prisoner's dilemma games can be set up in the abstract by varying the *payoff matrix* in ways like those shown in Figure 19.8. In experiments it is made clear to the subject what the payoffs are, and that one of the moves is more cooperative than others. Other moves may pay off more, depending on what the other person does, but if both players were to pick the cooperative move, both would win consistently and no one would lose.

Surprisingly, people tend to play the game competitively. In fact, in one experiment (Minas, Scodel, Marlowe, & Rawson, 1960), the matrix was fixed so that the cooperative move was also the most lucrative one for either player to make; still they tended to compete rather than cooperate, thereby losing money.

Cooperation can be induced in certain circumstances, however. Deutsch (1960) found that subjects modified their behavior considerably when instructed to play the game cooperatively, individualistically (i.e., without being concerned with how much the other player makes but only with one's own earnings), or competitively. In general, they would play as instructed.

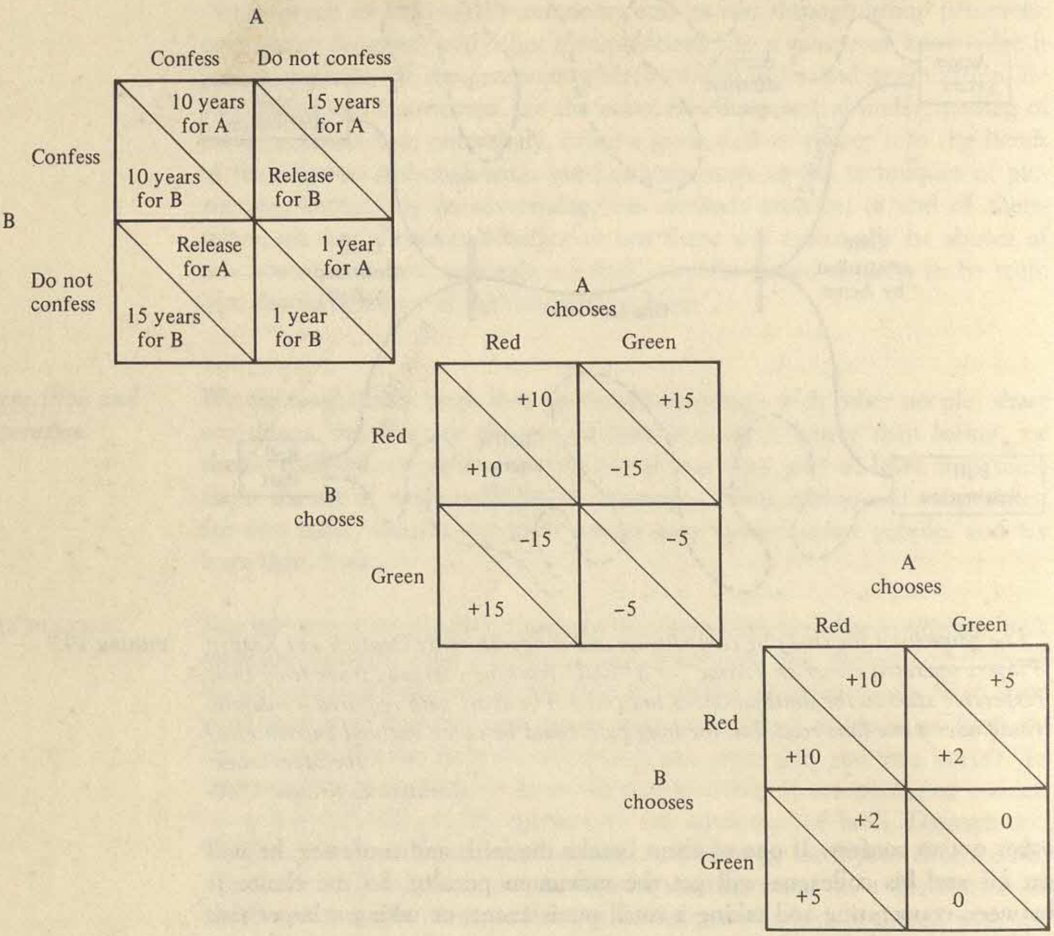


FIGURE 19.8 *Three gaming situations. In the upper panel is shown the prototype of the prisoner's dilemma game, as described in the text. Note that each box indicates the outcome for A in the upper right corner and the outcome for B in the lower left corner. The middle panel shows a prisoner's dilemma game in which A and B are playing for some reward, indicated by the numbers. Note that by both guessing red, they will both win 10 units. A will win a good bit if he guesses green and B guesses red, and B will win if he guesses green and A red. If they cooperate, both will guess red and win. In the lower panel is shown a game in which both A and B will win the most by cooperating, i.e., both choosing red.*

In some cases, also, when the stakes were fairly high and involved real money rather than just points, the subjects would cooperate more.

The amount of communication between subjects has been found to exert a major effect on cooperativeness. In the Deutsch and Krauss study it was found that when subjects were allowed to communicate with each other, there was more cooperation, and, when they were *forced* to communicate, there was still more cooperation.

Effect of Personality Variables

Some people are more competitive than others and, as you might expect, competitiveness is related to personality characteristics.

ACHIEVEMENT MOTIVATION

The achievement motive has already been discussed in Chapter 13, where it was pointed out that it seems to be associated with economic success. In particular, a person with a high level of achievement motivation is more likely to compete in situations where there are economic benefits to be gained than is a person low in achievement motivation. A high achiever, however, is more interested in games in which there is an element of skill than where mostly chance is involved.

Machiavellianism. Manipulation of others to one's own advantage often occurs in competitive situations, and some people are more manipulative than others. This tendency is called Machiavellianism (Mach, for short), and a scale to measure it was devised by Christie and Geis (1970). People who score high on the scale (high Machs) justify "white lies," making decisions ostensibly "for the good of other people," and using deceit when necessary; while low Mach scorers refuse to compromise with morality and believe people are basically honest and trusting.

When a high Mach and a low Mach are put into the same competitive situation, the high Mach will almost always win. He is unflustered by the pressure of the situation, is not inclined to take the other person's point of view, and is less likely to adopt conventional moral standards in unstructured games ("all's fair" is a more viable standard, according to the high Mach).

Consider the following situation: You have three subjects, one of whom is a high Mach subject. The other two are low or moderate Mach. You put $10 on the table and tell them that they can have it if two of them can agree on how to split it. Now the cooperative thing to do would be to split it three ways equally, with each getting $3.33. However, that is rarely what happens. Usually, through bargaining with two against one, the high Mach winds up getting considerably more than his share. Why? He is less bothered by conventional rules of fairness and has learned that he can violate them to his own advantage.

It is interesting that males who score high on the Mach scale are considerably more manipulative than females achieving the same score. It has been suggested that females may have other ways of manipulating people than being Machiavellian in the sense measured by the scale (Singer, 1964). For example, attractive females will often use their physical attractiveness to gain goals, while males may have to resort to more directly manipulative behavior.

Behavior in Groups

Much of what has already been said in this chapter and in Chapter 13 applies to human behavior in groups. The outcome of affiliative needs is grouping. The group situation is necessary for competition and cooperation to occur. Helping, liking, person perception, and persuasion all require at least two

people. Conforming, obedience, and attitude formation all occur in reference to demands placed on the individual by the group. Thus it is likely that the psychological processes already discussed in connection with interpersonal behavior are also applicable to the present topic. While this may be true, the present section will focus more upon some of the descriptive aspects of group behavior and influence that have not yet been covered. We shall consider three topics: the influence of the group on the behavior of the individual, the effect of group organization on its overall effectiveness, and group leadership.

EFFECT OF THE GROUP ON THE INDIVIDUAL

Groups differ in terms of their impact on the individual. Social psychologists and sociologists distinguish between *primary* and *secondary* groups. In primary groups the members are in more or less direct contact with each other, whereas in secondary groups contact is more indirect. The family is a good example of a primary group, whose influence is quite prominent in the development of the individual. Most church organizations and political parties are secondary groups, in that the contact between members is much less extensive. As you might expect, primary groups are more influential than secondary groups in affecting an individual's behavior.

A group that is highly influential in determining a person's behavior is called a *reference group*. Different people, of course have different reference groups.

The behaviors that one employs in a certain group situation constitute his *role* in that situation. Since individuals may belong to several or many groups, they may have several different, and perhaps incompatible, roles to play. The particular behaviors exhibited are usually those reinforced by the group. Successful membership in more than one group often demands that different behaviors be learned for each group and that the situations in which one or another set of behaviors is appropriate be discriminated.

Norms or behavioral expectations associated with a group can be very powerful influences on a person's behavior. For example, Catholic students were divided into two groups, one of which was reminded of their membership in the Catholic Church, the other not being so reminded. Both groups took a questionnaire, but those reminded of their religious affiliation answered the question in a more (Catholic) orthodox way than the other group (Charters and Newcomb, 1958).

New groups also develop norms that come to influence the members' behavior. Some years ago Sherif (1935) had groups of subjects view a stationary point of light in a completely dark room. Ordinarily, after a few seconds subjects will report seeing the light move. This is an illusion, called the *autokinetic effect*. Sherif found that subjects who viewed the light in a group situation and judged aloud the amount of movement on each trial gradually established a group norm, whereby all subjects came to report the same amount of movement. This behavior is a kind of conformity whereby a temporary group establishes a norm for interpreting some information. Significantly, if the subjects are aware of the illusory effect of the light (i.e., are told it is not really moving), the conformity does not occur.

Crowds and Mobs

Crowds and mobs seem to be unique in many ways. Things happen in mobs that could never happen in other situations, or so many of us think. Catastrophies may become more catastrophic because the people involved become disorganized, resulting in more casualties than might otherwise occur. For example, a fire breaks out in a discotheque and people run for the exits. Those not trampled are burned to death. Panic has multiplied many times the seriousness of the fire.

While disorganization is one characteristic of crowd behavior, you are probably also aware that mobs may become organized. This organization may lead to equally disastrous consequences—ethically and moralistically if not quantitatively. In a mob, for example, people may commit atrocities that would not happen with individuals acting as individuals. Thus behavior becomes organized toward a goal, and people who under other circumstances would be "normal" become caught up in the action.

Why do these two apparently contradictory states occur in crowds, and what can social psychology contribute toward understanding them? How can groups become catastrophically disorganized *at some times and catastrophically organized at others?*

Let us consider disorganization first. Some attempts have been made to simulate panic situations in the laboratory. For example, Mintz (1951) gave each of several subjects a wooden spool with a string attached. The spools were placed in a bottle with a narrow neck so that only one spool could be taken out a a time. Then water was pumped into the bottle and the subjects were instructed to get their spools out before they got wet. Although cooperation would have permitted everyone to get his spool out in time, the subjects did not cooperate. The bottleneck became a reality, and everyone tried to get through it at the same time. In a similar study Kelley et al. (1965) introduced an element of real fear by threatening to shock the subjects who did not "escape." The result was even more disorganization.

What might account for this behavior? Unfortunately, the experiments suggest no ready explanations, except that the elements of mob behavior may be seen in less than extreme circumstances. Perhaps, however, some of the knowledge you have already learned will help. First of all, try to think of any crowd situation as one in which everyone else's behavior is a potent stimulus to one's own behavior. In other words, a great deal of feedback *is involved. If you become agitated and run for the exits, I shall become agitated as well and run for the exits, which will in turn make you more agitated, and we shall wind up fighting for access to the exits. Multiply this by the number of people in the situation, and you can see that the panic would build up very quickly. This kind of feedback, you may recall from Chapter 4, is called* positive *feedback, and, unless something intervenes to dampen out its effects, it can rapidly create an unmanageable situation.*

The technology of crowd control in panic situations is aimed at just this problem—dampening the effects of positive feedback. What is necessary is either a great deal of pretraining as to how to behave in catastrophic situations—walk, not run, to the nearest exit—or a great deal of control over the situation as it develops, which is not often the case. Instructions as to what to do, to be calm and not to panic, are effective only if each person believes that obedience, considered in the context of the behavior of the person next to him, will not endanger his own safety.

Now for the second problem: organized mob violence. First of all, there is an important difference between a lynch mob and a panic mob: Nothing is threatening the immediate safety of the lynch mob. Thus, I do not interpret your mob-like behavior as a theat to my safety and vice versa, so I do not panic in response to your behavior. However, consider a few other aspects: In a large group you and I are less likely to be identified as individuals. Rather, we are simply "there," and whatever is happening is "happening." It is not we who are doing it. In other words, deindividuation occurs. Individuals become less identifiable as such, and responsibility for action becomes diffused so that no one person need think that he alone is responsible for whatever happens. The responsibility for action (assuming no threat to one's personal safety) is an important dampener of the positive feedback that might occur in such a group situation. If it is gone, what then happens?

Suppose someone with a minimum of authority (as for example, was the case in the Milgram obedience study) says "String him up!" If "him" happened to be someone you felt hostile toward anyway, then you could very well respond positively to the suggestion. Furthermore, considering the deindividuation and diffusion of responsibility in the crowd situation, you might be less apt to say no to such a suggestion, the dampening effect of responsibility having been reduced. Add to this the fact that you see other people responding in the same way, and another mob action is on the way to happening.

Once again, this kind of effect has already been seen in a simpler laboratory situation: Zimbardo found that students whose identities were obscured were more punitive to other people than those whose identities were obvious. Another related phenomenon that you have not yet encountered is the so-called risky shift. A number of studies have shown that people in group situations will take more chances than the same people would as individuals. The findings have held up in a number of gambling situations and presumably are caused by the diffusion of responsibility which, you may recall, has also been suggested as explaining why some people do not come to the aid of others in distress when in a group situation.

In other words, it may be that crowds and mobs are not really that unique. Perhaps the circumstances of their joining to form a group and the events to which they respond simply interact in profound ways with individual characteristics and tendencies that also operate in less drastic situations.

You have already read about other evidence of group effects on perceptual judgments, in the work of Asch described earlier in the section on conformity and compliance. Conformity in interpreting sense data is one of the basic demands placed on an individual by belonging to a group, and the group provides a basis for social comparison.

When one performs in a group situation, he often does better than when performing alone. This phenomenon is known as *social facilitation*, and it has been subjected to much study. The characteristics of the audience before which one is performing, as well as the extent to which one has learned the behaviors being performed, affect the amount of social facilitation. In general, previously learned habits are facilitated in the group situations, while new learning is inhibited (Zajonc, 1966). Also, an audience that is obviously attending to one's performance is more effective than the mere presence of other people (Cottrell, Sekerak, Wack, & Rittle, 1968).

EFFECTS OF GROUP ORGANIZATION

Most groups exist for some purpose, i.e., a goal that is its *raison d'être.* The family group, for example, has the goal of child rearing and education, as well as companionship and satisfaction of other personal needs. Other groups, such as work crews, task forces, etc., have some particular product to turn out. By and large, most of the studies of group effectiveness have focused upon situations in which the amount of some product or some other objective index of performance can be assessed.

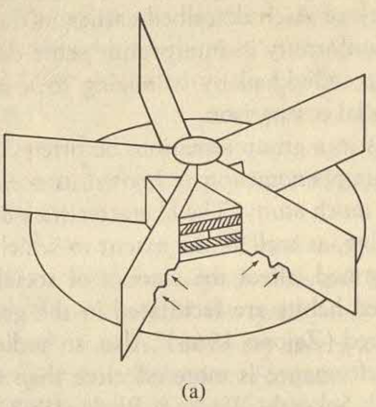
The way a group is organized is quite important in affecting how it will function, particularly when the task requires that information be communicated from one to another person within the group. One artificial problem-solving situation was set up by Leavitt (1951). Subjects were arranged in groups of five, and each given a card with five symbols on it, taken from a group of six: triangle, diamond, asterisk, circle, square, and plus. There was one symbol in common for all the group members; their task was to find out what that symbol was. They could not see each other, but they could pass messages back and forth in a predetermined manner. The five communication arrangements are shown in Figure 19.9. For example, in the circle, A could communicate with B and E but not with C and D. C could communicate with B and D but not with A and E; etc.

Leavitt measured the amount of time it took to come to a solution, the number of errors, and the satisfaction expressed by the members with the various arrangements. In general, the wheel and the Y yielded best performance, presumably because in each there was a central person who had access to all the information. The members, however, preferred working in the circle arrangement, perhaps because it was seen as more of a game.

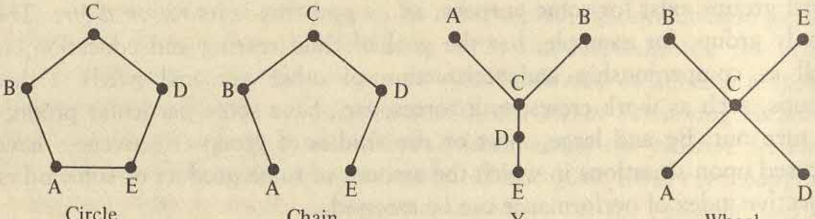
Other studies in the same vein have led to the general conclusion that for such artificial tasks the more intercommunication there is among the group members, the better the performance.

LEADERSHIP

The importance of leadership in affecting the behavior of individuals and groups should be clear to everyone. The ability to lead is a characteristic that is highly valued in most societies. However, at this point there does



(a)



(b)

FIGURE 19.9 *The study of communication nets by Leavitt. The subjects were seated at the apparatus depicted in (a), and could pass messages to other subjects, depending on whether the slots in the center at the partitions were blocked. The different arrangements studied are shown in (b).*
Leavitt, 1951.

not seem to be evidence for any general personality characteristics that go into making a good leader, i.e., one who would be effective in many different leadership situations. What appears to be the case, rather, is that different situations more or less call for different types of leaders. Person A would then be a good leader in situation X but not in situation Y. Furthermore, there is some indication that the behaviors engaged in by an effective leader in a particular situation can be learned by someone who otherwise would not appear to be a good leader (Havron & McGrath, 1961). In some sense a leaderless group will teach someone to be its leader, assuming that the members themselves have some conception of the requirement of leadership in that group.

Some groups seem to have two different kinds of leaders. From studies of military groups one of these has been termed the "task leader," the other one is the "social-emotional leader." (Bales & Slater, 1955). The task leader is the one who maintains the orientation of the group towards its goal, and who dispenses the rewards and punishments for members who do or do not contribute toward the group's productivity. The "social-emotional leader,"

on the other hand, is usually liked by most of the members, and rarely if ever administers rewards and punishments. Rather, he gives the members a sounding board for their feelings about the task leader and may serve as an intermediary between the members and the task leader, particularly when expressions of hostility are involved.

What kinds of leadership—democratic or authoritarian, rewarding or punishing—provide for the greatest productivity and satisfaction among group members? A classic, often-quoted study by Lippitt and White (1952) investigated this question. Eleven year-old boys were divided into groups and given the task of making papier mâché masks. The adult leaders for the groups (provided by the experimenters) behaved in an authoritarian way, a democratic way, or a *laissez-faire* way. The authoritarian leader made all decisions about what was to be done and who was to do it, otherwise remaining aloof. The democratic leader had his group make decisions as to how to proceed, once the long-range task was explained, and also exhibited more involvement in the group's activities than the authoritarian leader. The *laissez-faire* leader was essentially passive, giving aid only when asked. Otherwise the boys organized the tasks pretty much by themselves.

The behavior of the three groups differed considerably, with the democratic group showing more interest in the task, more autonomous motivation to complete it even in the absence of the leader, and more constructive suggestions as to how to proceed. In the authoritarian group work stopped when the leader was absent, and in the *laissez-faire* group work continued but was poorly organized and unproductive.

Other studies have indicated that the most effective type of leadership depends on the *power* of the leader, i.e., the extent to which he can control the reinforcements in the group. Also important are the way reinforcements are administered—coercively or positively—and whether the leader is liked, respected, and identified with by the group members. A rewarding authoritarian who is liked can be a very effective leader in some groups. Other factors affecting the outcome include the extent to which the group is placed under stress from time to time as in combat or in economic difficulties. Consequently, it is difficult to say precisely when one or another type of leadership will be most effective.

Summary

Social psychology includes the study of cognitive, motivational, and emotional factors that affect behavior in social situations as well as study of the social behavior itself.

Cognitive aspects of social behavior are organized around the concept of cognitive consistency, whereby one is thought to be motivated to maintain consistency among one's beliefs and opinions about related topics. Theories

of cognitive consistency include Heider's balance theory, Newcomb's balance theory, and Festinger's cognitive dissonance theory. In all three approaches consistency is seen as a positive motive.

People perceive each other on the basis of a number of traits, which, in a given individual are combined through an averaging process to yield an overall impression. Some traits, called central traits, are more important in determining the impression than others. In stereotyping, one infers a number of traits on the basis of only a limited amount of information. The perception of individuals affects the types of behavior we attribute to others. We are more likely to attribute good behaviors to attractive people who are perceived as being similar to ourselves, and high authoritarian individuals are more likely to be influenced by these factors than low authoritarians.

People are attractive or not for several reasons. Having a number of positive traits helps, but having a slight imperfection seems more attractive than being "perfect." People are more attracted to those who are near to them, and to those who are physically attractive. People who are more reinforcing are also more attractive, although an increase in the reinforcing value of an individual is more powerful in producing liking than a continuously high level of reinforcement. Ingratiation, or trying to please someone when there is an obvious ulterior motive, may lead to being disliked rather than liked.

Attitudes are dispositions to respond in particular ways to particular objects, and consist of a set of beliefs and opinions about that object, emotional responses to it, and a set of action tendencies in relation to it. Attitudes arise through processes of conditioning and learning, through modeling and as a result of various forms of social reinforcement, and through the necessities of maintaining consistency in one's cognitions and behaviors.

Attitudes may be changed through persuasive communications from a source whose prestige and credibility are sufficiently high, and when the target person permits the message to get through. A communication whose discrepancy from the target's attitude is only moderate, rather than extreme, is more likely to be effective. For more intelligent, well-informed target persons, a two-sided argument is more effective than a one-sided argument. The personality of the target person and his own behavior will affect attitude change. In general, females are more changeable than males. Also, persons of high self-esteem are harder to change than others. Inducing a person to behave in the desired manner may, through the dissonance created by attitude-discrepant behavior, induce the person to change his attitude. When persuasive communications are presented in a positive emotional context, they are more effective; also, inducing fear of dire consequences has been effective in changing attitudes.

Resistance to attitude change may be aided through inoculation or the presentation of weak arguments attacking the attitude. Apparently, such a procedure enables the target to prepare his defenses and makes him better able to stand the onslaughts of strong arguments later.

The humanistic values of altruism and helping others have been violated by recent events in which bystanders refused to help victims. Research sug-

gests that the presence of other people in an emergency situation reduces the tendency of people to help each other.

Compliance and conformity to some degree are socially necessary behaviors but have been observed to be extreme in certain laboratory situations. Subjects were demonstrated to conform to group judgments in obvious violation of their own sense experience, and to comply with an experimenter's demand to administer a lethal shock to a supposed victim. Conformity occurs because other people are in fact important sources of information, but it is more extensive with a larger group, and also is greater in people of low self-esteem. Compliance with demands to hurt another person is greater when the victim is not physically present. In nonpunitive situations compliance can be evoked by getting the subject to comply to a small request. Then he will be more likely to comply with a large request. Compliance is also greater in people who are made to feel guilty. In some cases attempts to manipulate people may backfire, and reactance, i.e., doing the opposite, may occur.

Competition and cooperation have been studied in game playing situations, including the prisoner's dilemma game. In most games, subjects prefer to compete rather than cooperate, even when they will earn more money by cooperating. Instructing subjects to cooperate, however, and increasing the communication between them, will result in more cooperation. Personality variables are important, especially the need for achievement and Machiavellianism, the tendency to manipulate others.

Groups have important influences on individuals. The *primary group* is the one with which one maintains closest contact and is most likely to serve as one's *reference group*, i.e., the group from which one's values and norms for behavior come. Multiple group membership may lead to conflicts in roles, i.e., behavioral expectations from a given group. These expectations can be important determiners of individuals' behavior. *Social facilitation* occurs when the presence of other people enhances a person's performance. While learned behaviors may be performed better, new learning is less effective in the social situation. The way in which a group is organized affects its productivity. In some situations, having a central person to channel information to the other members facilitated performance. Different groups seem to have different demands for leadership, and may "teach" a person to be the leader if none is otherwise available. Leadership functions may be shared between the "*task leader*" and the "*social-emotional leader*." Experiments have shown that democratic leadership leads to greater satisfaction among group members, as compared with authoritarian or *laissez-faise* leadership, although productivity may be comparable. Leaders have *power*, or the ability to influence the rewards of the group members, and effective leadership depends upon the effective use of this power.

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Glossary

Acculturation The learning of the behaviors and attitudes one is expected to adopt as a member of a particular culture.

Acetylcholine A neurochemical that acts as an excitatory transmitter substance at many synapses and at neuromuscular junctions.

Achievement Performance on a test of knowledge or skill; also a personal motive to accomplish difficult tasks.

Achievement motive The motive to succeed according to standards of excellence.

Acoustic array The pattern of sound waves impinging upon the auditory receptors. Features of this pattern specify the environmental events producing the sound waves.

Acquisition The gradual strengthening of a response through learning.

Acquisition curve The graphic representation of the acquisition process in which response strength is displayed on the vertical axis and amount of practice on the horizontal.

ACTH (adrenocorticotrophic hormone) A hormone secreted by the pituitary gland that causes the adrenal cortex to secrete corticosterone. It is secreted in response to stress.

Action potential (Also called *nerve impulse*) An electrochemical disturbance that is propagated along a neuron.

Acuity The ability of the eye to resolve spatial detail.

Adaptation A change in the sensitivity of a sense organ because of stimulation or the lack of it. Also, the process of adjusting to the environment through learning or the evolution of instinctive behavior patterns.

Addiction A state of physiological dependency upon a drug, characterized by an overpowering desire for the drug and a tendency to increase the dose.

Adrenal cortex Outer rind of the adrenal gland, which secretes several hormones, including corticosterone.

Adrenal medulla The inner core of the adrenal gland, which secretes the hormone epinephrine.

Afferent neuron A neuron carrying information to the central nervous system. Sometimes used synonomously with *sensory neuron*.

Affirmation rule With reference to concept learning, a rule specifying that all items with a particular attribute are instances of the concept.

Aggression Intentional behavior resulting in injury to some person or object.

All-or-none-law If a nerve impulse occurs at all, it will occur at the maximal amplitude; the magnitude of the impulse is independent of the intensity of the stimulus.

Alpha rhythm A wave pattern found in the EEG during periods of relaxed alertness, which has a frequency of 8 to 12 cycles per second.

Alternation An experimental method used in the study of thinking. The subject is required to alternate responses in a pattern such as left-right-left-right or left-left-right-right.

Amacrine cell A cell in the retina of the eye that transmits information laterally (across the surface).

Amnesia The inability to recall events in one's past, sometimes including one's own identity.

Amphetamine A drug that acts as a stimulant, increasing the arousal level.

Amplitude (*Intensity*) The physical strength of a stimulus such as a sound wave.

Amygdala A center in the anterior temporal lobe that modulates aggressive and other motivated behaviors.

Anal stage In psychoanalytic theory, the stage of development in which sexual motivation conflicts center on excretory functions and toilet training.

Anthropomorphism The attribution of human characteristics to subhuman species. Anthropomorphic explanations often attribute conscious thought, etc., to animals.

Anticipation method A method in verbal learning in which the subject, given one simulus word in a list, must respond with the next word in the list.

Antidepressant A drug, such as iproniazid, which elevates the mood and relieves depression.

Antisocial reaction A form of psychopathology characterized by little concern for other people or feelings of right and wrong.

Anxiety A generalized sense of fear or dread; also, a construct related to the conditioning of fear to an otherwise neutral stimulus; the expectation of punishment.

Anxiety, "free-floating". See *"Free-floating"* anxiety.

Anxiety reaction One of the major classes of neurosis, characterized by free floating anxiety.

Aphasia A language defect ordinarily due to brain damage or disease. It may be *sensory,* with some impairment in reading or understanding of speech, or *motor*, with impairment in the writing of speaking of language.

Appetitive behavior Behavior directed toward some positive goal.

Approach-approach conflict A conflict in which a person is motivated toward two incompatible goals.

Approach-avoidance conflict A conflict in which one is both attracted to and repelled by the same goal.

Aptitude The ability to profit from training in a particular field.

Archetype A symbolic representation of a universally meaningful concept in the inherited "collective unconscious," according to Jung.

Arousal Increased alertness and attention, accompanied by changes in the central and autonomic nervous systems and increased muscle tension.

Artefact In science, a result that is caused by some irrelevant aspect of the pro-

cedure employed, rather than by the phenomenon which one is investigating.

Assessment The evaluation of a person with respect to some psychologically meaningful characteristic, trait, or disposition.

Assimilation In Piaget's theory, the taking in of new information. Assimilation ultimately results in the accommodation of a schema to the new information.

Association A hypothetical connection that is established through learning.

Associationism The theoretical approach that complex ideas are the result of associations between simple elements.

Associative attribute In Underwood's theory of memory, one of the attributes of a memory. It consists of items to which that memory is linked associatively.

Associative cortex Areas of the cortex outside the primary sensory and motor areas.

Asymptote A value of a dependent variable beyond which there are no further effects of the independent variable.

Atmosphere effect The tendency for one to accept a positively stated conclusion when the premises are stated positively, or a negative conclusion in a context of negatively stated premises.

Attention The selective focusing upon certain aspects of experience, to the neglect of others.

Attitude A disposition toward a person or other object. It consists of beliefs and opinions, emotional responses, and action tendencies.

Attribute A perceived characteristic of some object or person. As a verb, it means to infer that an individual has certain characteristics.

Authoritarianism A set of traits characterizing an individual who seeks security in authority and in a social hierarchy in which everybody has and knows his place.

Autistic A term referring to psychological processes that do not correspond to reality and are strongly determined by a person's needs. Also refers to a severe mental illness of early childhood, involving extreme withdrawal and isolation, absorption in fantasy, and profound defects in thought and language.

Autokinetic effect Apparent movement of a small spot of light seen against a dark background in a completely dark room.

Autonomic conditioning Conditioning of responses of the autonomic nervous system, including salivation, galvanic skin response, gastric motility, etc.

Autonomic nervous system A division of the nervous system supplying certain endocrine glands and smooth muscles. It controls changes in the body during emotion as well as other homeostatic functions.

Autonomy Self-determination; as a need, it is a need to be self-determining.

Aversive behavior Behavior aimed at avoiding unpleasant consequences.

Aversive conditioning Instrumental conditioning in which an aversive stimulus can be prevented by making an appropriate response.

Avoidance-avoidance conflict A conflict between two equally aversive goals.

Axon The part of a neuron that carries information away from the cell body.

Balance theory A theory of cognitive consistency according to which one's attitudes and beliefs toward persons and objects tend toward balance.

Barbiturate A class of drugs that depress the central nervous system.

Basic anxiety In Horney's theory, the anxiety that arises out of the helplessness and insecurity of childhood.

Behavior disorder A general term referring to one of the various categories of psychopathology.

Behavior genetics The study of the mechanisms whereby specific behaviors are inherited.

Behavior modification A form of psychotherapy focusing upon the elimination of behavioral symptoms and the learning of new behaviors through classical and instrumental conditioning procedures.

Behavior therapy The same as ***behavior modification.***

Behaviorism A school of psychology founded by John B. Watson, which opposed the use of introspection and subjective concepts and advocated the study of overt behavior.

Belladonna A drug that inhibits the action of acetylcholine.

Beta rhythm An EEG rhythm with a frequency from 13 to 25 hertz and a low amplitude that occurs during states of alertness.

Biconditional rule In concept learning, a rule that states that a given item is an instance of the concept if it possesses a given attribute, but only if it also possesses a second attribute.

Binary A term referring to a system with two possible states. Binary numbers have only two values 0 and 1.

Binocular disparity The spatial difference in stimulation of the two eyes from a three-dimensional scene.

Bipolar cells Cells in the retina of the eye that are interposed between the rods and cones and the ganglion cells.

Body language A term referring to nonverbal communication by means of gestures, postures, expressions, etc.

Brainstorming A technique for problem solving by groups, in which ideas are expressed without criticism or evaluation.

Brainwashing Techniques employed in systematic attempts to change attitudes.

Brocca's area One of the areas of the cerebral cortex, located in the frontal lobe, which is important for the motor aspects of speech.

Castration anxiety In Freudian theory, the fear experienced by a male child that he will be castrated by his father in reprisal for his sexual attraction to his mother.

Catatonic schizophrenia A category of schizophrenia characterized by "waxy flexibility" and negativism.

Cell body (Soma) The part of the neuron containing the nucleus, as distinguished from the axon and the dendrites.

Cerebellum A part of the hindbrain that is important for balance and the coordination of movements.

Cerebral cortex The outer covering of the cerebrum, consisting mostly of gray matter (cell bodies).

Cerebrotonia In Sheldon's personality typology, a temperamental state characterized by fast reactions, social inhibition, rigid bearing, and the tendency to be a "loner." It is associated with the ectomorphic body build.

Cerebrum The largest forebrain structure, divided into the cerebral hemispheres.

Chaining Acquisition of a series of behaviors in which one response comes to be the stimulus for the next response in the series.

Chlorolabe A pigment contained in the cones of the retina that absorbs light in the green region of the spectrum.

Choleric A temperamental characteristic in Hippocrates's system. A choleric person is easily angered.

Chromosome Structures in the nucleus of the cell containing the genes, by means of which hereditary characteristics are transmitted.

Ciliary muscle The muscle within the eye that is responsible for accommodation of the lens.

Circadian rhythm A physiological and/or psychological rhythm with a period of about 24 hours.

Clairvoyance An alleged phenomenon in which the subject becomes aware of external objects that cannot affect his sense organs; a form of extrasensory perception (ESP).

Classical conditioning (Also known as *Pavlovian* or *respondent conditioning*) A form of learning in which a response comes to be given to a neutral, conditioned stimulus as a result of its being paired with an unconditioned stimulus.

Clinical psychology A branch of psychology concerned with assessment and treatment of behavior disorders (mental illness) and with research into their causes.

Closure The tendency to perceive gaps as being filled in.

Cochlea The bony structure containing the receptor organ for hearing.

Coding The transformation of data from one form into another so that it can be communicated over some channel (e.g., transforming the information in a stimulus into a pattern of nerve impulses).

Cognitive consistency An approach to attitude formation and change that stresses the motive to attain consistency between one's various beliefs, emotions, and behaviors; also such a state of consistency or congruity.

Cognitive dissonance A theory of cognitive consistency that stresses that individuals are motivated to change beliefs, etc., to achieve a state of consistency and to avoid dissonance.

Cognitive psychology An approach to psychological phenomena that focuses upon hypothetical cognitive structures (representations of experience), rather than upon responses.

Cognitive style One's individual approach to perceiving and thinking about events.

Coherence The quality of systematic and predictable connection; consistency.

Collective unconscious In Jung's theory, one of the two parts of an individual's unconscious mind, a storehouse of racial memories and psychic material that is inherited and shared with other members of the species.

Color blindness A complete or partial inability of an individual to distinguish two or more colors.

Color circle A circular arrangement of hues in which sectors of complementary colors are opposite and in which saturation of color is represented by the radial distance from the center.

Color solid. A three-dimensional diagram that represents the relationship of hue, saturation, and brightness in the perception of color.

Common fate A Gestalt law of organization proposing that items which function, change, or move in the same direction will be perceived as belonging together.

Community psychology The attempt to bring public health principles to the area of psychological treatment. Characteristics include crisis intervention in psychiatric emergencies, inexpensive specialized psychotherapy for the poor, and attempts to resolve community problems that may produce behavior disorders.

Comparative psychology The branch of psychology that compares the behavioral characteristics of one species with those of another.

Compensation A defense mechanism in which one activity is substituted for another in an individual's attempt to satisfy frustrated motives. Usually, failure in one activity is compensated for by efforts in another, separate realm of activity.

Competence A level of capability that makes possible effective interaction with the environment.

Complementary colors Pairs of hues that yield gray or white when mixed.

Compliance Producing behavior that conforms to pressures of an authority or a group and which is elicited without necessarily accepting group values and norms.

Compulsion Being forced to perform an act; a strong irrational impulse to do something contrary to one's will; a stereotyped, repetitive, and insignificant motor activity that an individual feels impelled to do.

Concept formation Grouping objects or ideas in terms of some common property so that an abstract idea may be generated or a conclusion drawn.

Concordance In genetics, having the same trait(s) as a relative under study, usually an identical or fraternal twin.

Concrete operations The third stage of Piaget's characterization of a child's mental development; the ability to use rules based on concrete examples, although the child cannot yet deal with abstract qualities.

Conditional rule In concept formation, if an item has one specified property, then it must also have another property in order to be an instance of the concept.

Conditioned reflex A learned response elicited by conditioned stimulus.

Conditioned response (CR) See *Conditioned reflex.*

Conditioned stimulus (CS) A once-neutral stimulus that evokes a given response after it has been paired with an unconditioned stimulus during a training period.

Conduct disorder Any of several behavior deviations in which behavior violates accepted moral codes but with the absence of anxiety or irrationality; e.g., addictions, psychopathic personality, etc.

Cones Photosensitive retinal receptor cells closely packed in the fovea, which are responsible for color vision and high visual acuity, especially for daytime seeing conditions.

Conflict frustration Frustration of a motive because it is in conflict with some other motive.

Conformity The tendency to change attitudes or behavior in accordance with peer group pressure; to acquiesce to group norms.

Congenital A characteristic acquired during development in the uterus and not through heredity; existing at or dating from the time of birth.

Conjunctive rule In concept formation, the rule that all examples of a concept must have one or more attributes in common.

Connotative meaning The emotional and evaluative meaning of a concept.

Consciousness The sum total of a person's mental experiences; one's awareness of his thoughts, ideas, actions, environment, etc.; the self.

Conservation According to Piaget, a child's ability to respond to invariant properties of phenomena and also to disregard transformations that are irrelevant.

Constancy The tendency to perceive the properties of objects as unchanging in spite of changes in the retinal image.

Construct An abstract concept, trait, or dimension used in the formulation of a theory that can only be verified indirectly.

Contact analog display An integrated visual display presented so that the information one receives is analogous to what one would get from direct visual contact.

Continuation The perceptual tendency to see objects in the form of a line, curve, or some other continuous pattern.

Continuity approach A learning theory that proposes that learning occurs by a gradual or continuous strengthening of associations, rather than by an all-or-none process.

Control The manipulation of some group or condition in an experiment designed to test the effects of the independent variable.

Control group That group of subjects in an experiment which is the same in all respects as the experimental group, except that it does not receive the treatment of the independent variable.

Convergent thinking Thinking directed toward accepted conventions and social mores.

Conversion reaction The neurotic manifestation of bodily symptoms not based on any physical illness but seeming to result from anxiety or psychological conflict.

Convulsion A contraction of the voluntary muscles that is both violent and out of one's control.

Cornea The outermost structure of the eye, forming a transparent covering that allows light to pass through to the interior.

Correlational method A method for studying natural phenomena, based on the relationships among two or more variables.

Corticosteroid A group of chemicals produced by the metabolism of cortisone and other chemical secretions of the adrenal cortex. These chemicals have been shown to increase during acquisition of a conditioned emotional response.

Corticosterone A hormonal secretion of the adrenal cortex responsive to changes in the level of ACTH in the bloodstream. It functions to reduce inflammatory reactions.

Cortisone A hormone secreted by the adrenal cortex in response to stress, serving to reduce inflammation.

Counseling psychology The branch of psychology providing assistance in dealing with individual problems of a vocational or personal nature.

Counterconditioning The weakening or elimination of a conditioned response by the learning of a new response that is incompatible with, and stronger than, the one to be extinguished.

Creative thinking A process of thought resulting in new and original ideas. A dimension for the evaluation of the products of thought, whatever their form or content.

Creativity-growth group A group designed to "release" one's creativity and "growth potential" using any of a wide variety of methods, such as dance, yoga, fingerpainting, etc.

Crisis intervention A major feature of the primary prevention approach to mental health, whereby someone is always on call to help in an immediate crisis.

Criterion In regard to testing, the job or performance to be predicted by the test; in learning, that point at which relatively complete learning is presumed to be represented.

"Culture-fair" test A test of intelligence designed to reduce bias resulting from cultural experiences or membership in a different social or ethnic group.

Cumulative recorder An instrument for recording and displaying the total number of responses over time.

Cyanolabe A pigment in retinal cones that absorbs light corresponding mostly to the wavelength of blue.

Decibel A unit for measuring physical sound intensity.

Deduction The logical process of deriving specific consequences from general propositions.

Defense mechanism A method used, usually unconsciously, by an individual to prevent experiencing anxiety. Examples of defense mechanisms are denial, repression, projection, rationalization, and reaction formation.

Deindividuation Lack of recognition of individual characteristics and identifications in certain social situations such as mobs and crowds.

Delusion A belief or thought that a person maintains as true despite irrefutable evidence that it is false.

Dendrites Short filamentous process extending from the cell bodies of neurons and increasing the receptive surface of the nerve cell.

Denial A defense mechanism in which there is minimization of the importance of a situation or event or of unacceptable impulses or feelings.

Deoxyribonucleic acid (DNA) Molecule found in the nuclei of cells, thought to determine the genetic characteristics carried by the chromosomes.

Dependency Reliance upon others for advice, support, and assistance.

Dependent variable That factor or condition about which predictions are made in an experiment. Changes in this variable depend upon changes in the independent variable.

Depersonalization Loss of sense of distinct personal identity.

Depression A state of extreme sadness and dejection. Depression is sometimes classified as a neurotic or psychotic reaction to the extent that it is extremely intense or long-lasting and is accompanied by inactivity, disturbances in thinking, and reduced sensitivity to stimulation.

Desensitization A form of behavior therapy in which the individual is reconditioned so that previously aversive stimuli no longer elicit anxiety responses.

Developmental psychology The specialized area within psychology that studies the changes in physiology and behavior between birth and death.

Deviance Departure from what is considered to be correct, normal, proper, etc. In statistics, the departure from the norm or mean.

Deviation IQ The IQ that is obtained by comparing an individual's score with the scores of others in his own age group. Expresses the extent to which an individual deviates from the average score obtained by his peers.

Dilation Increase in the size of the pupil as a response to less light entering the eye.

Discrimination In learning, the ability to withhold a behavioral response except in the presence of a specific stimulus, or to respond differently to different stimuli.

Discrimination learning Learning to distinguish between two or more different stimuli, or between the presence and absence of a stimulus.

Discriminative stimulus (S_D) A signal presented only when reinforcement is present or is to follow, thereby controlling the occurrence of the response.

Disjunctive rule In concept formation, a rule which specifies that any object having a particular attribute is an example of a given concept.

Displacement A defense mechanism in which behaviors are directed toward

something or someone other than the person or situation actually responsible for the feeling.

Dissociative reaction A neurotic defense mechanism in which certain aspects of one's character or memory are repressed and thus separated from consciousness, as in amnesia, multiple personality, or fugue states.

Distinctiveness The tendency of some items to "stand out" from the context in which they occur. Distinctiveness is one factor determining how well material can be learned.

Distortion The misperception or cognitive alteration of aspects of a situation by various processes so that the realities of the situation are not apparent or are disguised.

Distracting task A task that is assigned to the subject of a memory experiment between the time of presentation of the material to be learned and the time of recall or recognition, thus interfering with the rehearsal and processing of that material into memory.

Distributed practice. Dividing up the allotted learning time for a task into several periods.

Divergent thinking A way of thinking in which many different answers, rather than just one, are produced.

Dominant gene A gene that always completely determines a particular hereditary characteristic.

Double-bind theory Theory of the etiology of schizophrenia that traces its origins to contradictory, conflicting messages received by the individual in his social environment, most particularly in his family.

Down's syndrome Mongolism; the technical term for a congenital type of mental retardation with such physical symptoms as thick tongue, eyelid folds that make the eyes appear slanted, and heart abnormalities.

Drive Term commonly applied to a factor that provides a motive for some behavior. May be aroused by deprivation of some biologically necessary substance (i.e., food), rather than by psychological or social needs.

Eclecticism An approach to psychotherapy that makes use of a variety of procedures, rather than a particular one, the choice in each case depending on the individual patient and circumstances. In general, the policy of accepting a variety of approaches rather than just one.

Echoic memory Information stored briefly as an auditory image of a stimulus.

Ectomorph An extreme body type characterized by leanness and associated with the personality temperament cerebrotonia.

Educable mentally retarded (EMR) Mildly retarded individuals who may be educated to at least a minimal degree, enabling them to function in society and perhaps support themselves.

Edwards Personal Preference Schedule (EPPS) A test designed to measure the needs proposed by Murray's theory of personality.

Effector An organ, gland, or muscle that responds to neural impulses received from an effector nerve.

Efferent Carrying nerve impulses outward from the central nervous system to an effector.

Ego A Freudian term referring to the self or that part of the personality which deals with the environment realistically. It delays immediate gratification when necessary, channeling behavior into socially acceptable outlets.

Egocentrism In Piaget's theory, a characteristic of a child's thought processes showing the lack of ability to comprehend the view or outlook of another.

Electra complex In Freudian theory, a sexual craving of a girl for her father developing during the phallic stage and subsequently repressed. This corresponds to the Oedipus complex in boys.

Electroconvulsive shock A form of psychotherapy used in the treatment of manic depressive psychosis and schizophrenia; an electrical current is passed through the brain resulting in convulsions and a short period of unconsciousness.

Electroencephalogram (EEG) A recording of the electrical activity of the brain.

Electromagnetic spectrum The variety of changes occurring in electrical and magnetic fields measured in terms of wavelength or frequency of vibrations.

Empirical That which is based on the observation of events occurring in an experiment or in nature, as distinguished from that founded on opinion, beliefs, or reasoning.

Empiricism A belief that behavioral tendencies and knowledge depend upon learning, experience, and factual observations.

Enactive representation A term used by Jerome Bruner to refer to the internal representation of motor sequences; a neurological program determining an extended sequence of movements.

Encephalitis Any type of infection of the brain causing inflammation.

Encounter group A form of group psychotherapy focused on personal growth, more effective interpersonal communication, and open expression of feelings. The aim is a more direct encounter with one's own feelings toward others, and vice versa.

Endocrine glands Ductless glands that secrete hormones directly into the bloodstream.

Endomorph A body type characterized by plumpness and associated with a viscerotonic temperament.

Engram A hypothetical physiological change corresponding to something learned, also called a memory trace.

Environmentalism A belief that hereditary has only a minor role in behavior, but that individual differences are caused by one's environmental differences.

Enzyme A complex protein substance acting as a catalyst in regulating chemical reactions in the body.

Epinephrine A hormone secreted by the adrenal medulla that excites the sympathetic nervous system. It transmits nerve impulses across synapses within the sympathetic nervous system. Also called adrenalin.

Erythrolabe A pigment in retinal cones that absorbs light mostly in the red region of the spectrum.

Estrogen A female sex hormone secreted by the ovaries, which maintains sexual characteristics and the reproductive functions.

Eugenics The study of means of improving the human species by selective mating.

Euphoria Feelings of well-being, often magnified out of proportion with reality.

Evolutionary biology Study of living organisms stressing the importance of understanding the similarities and differences between animals.

Excitation General level of arousal or a state of activity stemming from arousal; stimulation resulting from the firing of nerve cells; agitated emotional state.

Existential therapy A phenomenological type of psychotherapy that focuses upon

scious conflicts. The therapist attempts to lead the patient to a realization of his goals by helping him to regain a sense of control over his life.

Existentialism A philosophy which adheres to the idea that at any moment in time man is in a state of growth toward whatever he wills to become. Proponents of this view deny the validity of abstract conceptions of the nature of man, saying that man simply *is* and becomes what he will.

Exocrine glands Glands that make use of ducts to carry their secretions to other parts of the body.

Expectancy Learned anticipation by an organism that a certain response to a stimulus will result in the occurrence of a specific situation.

Experiment A scientific procedure in which variables are manipulated in order to discover relationships or laws governing behavior or events.

Experimental group Those subjects in an experiment who receive the experimental treatment.

Experimental method See *Experiment.*

Experimental neurosis The result of an experimentally induced conflict in which an animal is unable to respond in a difficult discrimination situation. At a critical point the animal finally "breaks down," exhibiting indiscriminate, restless behavior.

Experimental psychology A field of psychology that studies behavior by performing experimental research. Problem areas investigated are learning, perception and sensation, memory, motivation, and the underlying physiology of behavior.

Exploratory drive An unlearned tendency to investigate novel stimuli or situations.

Extinction A procedure for eliminating a particular behavior by repeatedly presenting a conditioned stimulus without reinforcement or without the unconditioned stimulus.

Extrasensory perception Alleged ability to get information about ideas or objects through some means other than the usual sensory channels. This phenomenon includes telepathy, clairvoyance, and precognition.

Extrovert A person characterized by more attention to external stimuli than to his internal thoughts and feelings; he is more spontaneous, distractible, and changeable in mood than the introvert. Introversion-extroversion is one of the major dimensions in Eysenck's theory of personality. See *Introversion.*

Factor analysis A statistical method used to group tests, based on the extent to which they measure the same thing.

Fantasy Images or mental representations of objects or events that may or may not be real.

Feedback Information received by an individual on the effects of some previous action, allowing him a basis for correction of error; also termed knowledge of results. In general, information from an output is "fed back" to the input. Thus affecting the response of the system to future inputs.

Fiber tract A group of axons located within the central nervous system.

Figure-ground The organization of perceptual experience into two main components: the focal stimulus, or figure; and background.

Filtering A hypothetical perceptual process involving selective attention that prevents unimportant signals from reaching awareness. New, unusual, or important signals, however, are processed into consciousness, implying that the stimulus meaning can be discriminated by this process.

Fissure A relatively deep indentation in the cerebral cortex.

Fixation A persistent response to frustration in which an individual continues to repeat a behavior in spite of its being incorrect or nonreinforcing.

Fixed interval schedule A plan of partial reinforcement in which the first response occurring after a certain amount of time has elapsed is reinforced. Responses occurring before the interval has elapsed are not reinforced.

Fixed ratio schedule A plan of partial reinforcement in which the subject is rewarded each time a set number of correct responses have occurred.

Forebrain The frontmost division of the brain, encompassing the thalamus, hypothalamus, and cerebral hemispheres.

Forgetting A loss of ability to remember all or part of material that has been learned or experienced in the past.

Formal operations In Piaget's theory of intellectual development, the stage of adult thought in which the child becomes capable of using abstract rules. Begins at about 11 years of age and continues through adulthood.

Fraternal twins A pair of twins developed from separate fertilized eggs, each with individual genetic makeup. Also termed dizygotic twins.

Free association A psychoanalytic technique in which the patient spontaneously says all that occurs to him without exception. It is aimed at uncovering one's unconscious thoughts and ideas.

"Free-floating" anxiety A vague fear with no apparent object. The main symptom of an anxiety reaction.

Frequency The number of times something occurs within a given length of time. The number of vibrations or cycles per second reaching a given point in space; often refers to a dimension of sound.

Frequency distribution Classifying data by arranging a set of measurements from highest to lowest (or lowest to highest) and plotting the number of cases at each value or interval.

Frequency principle A physiological law stating that a neuron will fire more rapidly to stronger stimuli than weak ones, generating more action potentials per given period of time.

Frustration Feeling engendered by being blocked from attaining a goal or gratification; also the process of blocking motivated behavior.

Frustration-aggression hypothesis A theory proposed by Dollard and Miller according to which the only cause of aggression is frustration.

Fugue A temporary state occurring in dissociative reactions in which there is loss of memory along with flight to another place, and assumption of a new identity.

Functional fixedness A tendency or set in which one considers only the common function of objects, rather than the possibilities for novel or unusual functions. It is a factor hindering problem solving.

Functionalism A psychological viewpoint proposing the study of adaptive behavior and experience.

"G" factor A hypothetical factor, presumably measured by a test of general intelligence, which affects performance on a variety of different tasks, in distinction to specific aptitudes.

Galvanic skin response (GSR) A decrease in the electrical resistance of the skin that occurs during emotion, due to sympathetic nervous system activity.

Gamete The mature reproductive cell; may refer to either the sperm or the egg.

Ganglion A collection of the cell bodies of neurons outside of the central nervous system; a name referring to certain cells in the nervous system.

Gene The basic unit for the transmission of hereditary characteristics, carried in chromosomes.

Generalization The application of a response to a whole class or group after having been conditioned to respond to a limited number of the members of the class or group.

Genital period In psychoanalytic theory, the final psychosexual stage during which puberty occurs and sexual interest shifts to heterosexuality.

Gestalt In perception, a unified configuration which has specific properties that cannot be derived from summing up its separate parts.

Gestalt psychology A school of psychology which contends that stimuli are perceived as wholes, rather than as summations of parts; that the whole determines the characteristics of the parts, and not vice versa.

Gestalt therapy A form of psychotherapy originated by Fritz Perls which attempts to broaden awareness by using recall of past experiences, bodily sensations, etc. The goal is to enable a person to form meaningful configurations of awareness.

Gland An organ that secretes a chemical substance. The two general types are *endocrine glands* and *exocrine glands.*

Good form A Gestalt principle of organization which asserts that, wherever possible, the best (simplest, most symmetrical) figure will be perceived.

Grammar The rules for combining words and phrases into meaningful sentences.

Group therapy A specialized form of psychotherapy in which a group of people discuss their problems together with the same therapist.

Grouping The tendency to perceive objects in groups, rather than as isolated elements; is determined by proximity, similarity, good form, and continuity.

Habit A learned response that becomes fixed and relatively automatic through constant repetition.

Habituation (1) Decreased response to a stimulus because it has become familiar. (2) A condition resulting from repeated use of a drug and characterized by a desire for the drug, little or no tendency to increase the dose; and psychological, but not physical, dependence.

Hallucination Perception of an external object when no such object exists.

Halo effect The effect that the general impression of a person has on another person who is rating specific characteristics of that person.

Haptic system The perceptual system whereby object properties are perceived through active touch. It includes the tactile sense as well as proprioception.

Hebephrenic schizophrenia A type of severe schizophrenia characterized by regressive behavior, silliness, and loss of touch with reality.

Hedonic Motivation to seek pleasure and avoid pain.

Heredity The biological transmission of genetic traits from parent to offspring.

Hermaphrodite An animal or plant having both male and female reproductive organs.

Hertz (Hz) A frequency measurement of cycles per second.

Higher-order conditioning Conditioning a response by pairing a new stimulus with another stimulus to which the response has previously been conditioned.

Hindbrain The division of the brain containing the medulla, pons, and cerebellum. Also known as the rhombencephalon.

Homeostasis The tendency of the body to maintain internal physiological conditions within certain limits.

Homeostatic mechanisms Mechanisms for achieving homeostasis.

Homosexual A person who has sexual desires for, or relations with, members of his own sex.

Homosexual panic In a heterosexual individual, the fear arising from homosexual thoughts or the suggestion that one might have such.

Hormone A chemical substance secreted by the endocrine glands that regulates physiological activity.

Hostility Angry, hateful, or destructive behavior against another. Also the motive to behave in such a way.

Hue Color gradation; one of the three aspects of color permitting its discrimination from another color. Hue is the psychological correlate of wavelength.

Human engineering The field of psychological specialization concerned with the design of equipment and the tasks performed in the operation of equipment.

Humanism In psychology, a recent movement in personality and clinical psychology focusing upon uniquely human experience, rather than abstract conceptions of human nature.

Humanistic psychology See *Humanism.*

Hunger A drive state based on the deprivation of food; also, the feelings associated with such deprivation.

Hyperopia Farsightedness. The inability to see near objects clearly because the image is focused behind the retina instead of on it.

Hypertension A condition of abnormally high blood pressure.

Hypnagogic imagery. Imagery that occurs as one is dropping off to sleep. It may be visual, auditory, or somesthetic, and is more vivid in some people than in others.

Hypochondriasis A neurotic reaction in which a person is excessively concerned with his physical health or welfare.

Hypothalamus A region of the forebrain that controls the involuntary functions through the autonomic nervous system and helps to control many basic drives and emotional processes including sleep, thirst, temperature, sex, and hunger.

Hysteria A neurotic disorder characterized by a non-neurologically based physical symptom such as blindness, immobility, or anesthesia over some part of the body. Also called conversion reaction.

Iconic memory The transient representation of the "raw" visual stimulus, lasting about .5 second.

Id In Freudian theory, the unconscious portion of the personality, which consists of primitive impulses, drives, and instincts.

Identical twins Two individuals with identical chromosomal patterns, having both come from a single egg that divided after fertilization; monozygotic twins.

Identification A defense mechanism in which one sees himself as being like another, and adopts the characteristics and values of that person. This is an important mechanism in the development of appropriate adult roles and behavior.

Identity crisis The main problem of adolescence, according to some personality theorists, caused by the need of a teen-ager to find an appropriate person with whom he can identify as a way of finding out "who he is."

Illumination A stage in problem solving in which the answer seems to come in a flash of insight, unexpectedly, often accompanied by an emotional feeling.

Illusion A distorted or false perception of an object, or an object or event that induces a false perception.

"Imageless thought" Thought that seems not to involve any images or other conscious content; refers particularly to one approach to the nature of thinking in which the role of imagery is minimized.

Imagery A characteristic of verbal material that tends to evoke images or internal symbolic representations; the representations themselves.

Implicit behavior Covert movement of muscles not readily detectable; believed by some to be involved in thinking.

Imprinting A type of learning occurring at a critical stage of development, in which attachment to the mother is formed, usually seen in certain species of birds.

Incentive A goal, as manipulated by the experimenter to control goal-directed behavior; the amount of reward.

Incubation A stage in problem solving during which there is no active attempt to solve the problem, yet unconscious processes seem to be working on the solution.

Incus The middle of the three tiny bones in the middle ear which conduct sound from the eardrum to the cochlea.

Independent variable The condition that is varied or manipulated by the experimenter in an experiment. See also *Dependent variable.*

Individual differences Traits providing the basis for distinguishing between members of a species; a term particularly used in referring to differences in test performance.

Induction The logical process of arriving at general conclusions from specific data.

Industrial psychology An applied branch of psychology that studies ways of improving efficiency in industry, both in terms of human beings and machinery. This area devises methods of selection, training, and counseling of personnel.

Inferiority complex A term used by Alfred Adler to mean the basic feelings of inferiority developed during childhood as a result of frustration in one's striving to gain power.

Information processing An approach to psychological phenomena, such as perception, learning, and memory, that focuses upon hypothetical stages in the handling of information.

Infrared rays An invisible part of the electromagnetic spectrum whose wavelengths are longer than visible red; experienced as heat.

Ingratiation Behaving in a friendly, positive manner toward another with the aim of manipulating that person in order to serve one's own purpose.

Inheritance The genetic composition of an organism, largely determining the structure and mode of operation of his biological processes.

Inhibition A reduction of response due to suppression or restraint; a decrease in the firing of a neuron; in Freudian theory, the resistance of the superego against the instinctual impulses of the id's reaching awareness.

Innate releasing mechanism An internal mechanism of an organism's nervous system triggering a *fixed action pattern* (instinctive pattern) when a releasing stimulus is presented.

Inside-out display A display of the position of a vehicle from the point of view of one that is inside the vehicle, looking out.

Insight In problem solving or learning, the sudden emergence of the answer to a problem; understanding one's own behavior and the causes of it.

Instinctive behavior Unlearned patterns of behavior with a usually complex form that characterize a particular species.

Instrumental behavior Activity that usually achieves some goal or satisfies a need.

Instrumental conditioning Acquisition of new behavior that has the effect of obtaining a reward or avoiding punishment.

Insulin A hormone secreted by the pancreas, involved in the utilization of sugar and carbohydrates by the body; used in insulin shock treatment.

Intelligence A concept applied to a person's capacity to learn and to deal with abstract problems and concepts.

Intelligence quotient (IQ) The mental age, as determined by an intelligence test, divided by the chronological age (in months) multiplied by 100; more commonly, any score on a standardized intelligence test, transformed to a scale with a mean of 100 and a standard deviation of 15 or 16.

Interference The obstruction of learning something new, caused by previously or subsequently learned material; a theory of forgetting invoking the above process.

Interval scale A scale having a unit of measurement that is of the same value throughout the scale.

Introspection A psychological method for looking inward at the thoughts, feelings, and sensations one experiences in order to analyze them.

Introvert A person who is more concerned with his own thoughts and feelings than with external stimuli. (See *Extrovert*).

Iris The colored part of the eye containing the pupil, which is a group of muscles that determine the amount of light entering the eye.

Kinesthesis The sense of movement in the body and position of the body and limbs in space.

Kymograph A device, now rarely used, for recording the strength of a response on a moving drum.

Labyrinth The area in the head containing the organs of the middle and inner ear.

Language An organized set of symbols and syntactical rules used for communicating and thinking.

Latent content The underlying content and meaning of dreams, often expressed in symbolic form.

Latent learning Learning that appears to occur in the absence of reinforcement, facilitating performance in later trials when reinforcement is introduced.

Latent period In psychoanalytic theory, the period of middle childhood between about ages 6 and 12, during which certain defense mechanisms, such as sublimation and reaction formation, develop.

Law of effect A proposal by Thorndike which suggests that behavior is satisfying or pleasing is "stamped in," while behavior that leads to annoyance or unpleasantness is "stamped out." In general, the principle that reinforcement is necessary for, or facilitates, learning.

Learning set An acquired ability to learn more rapidly in new learning situations because of previously learned responses.

Lens The part of the eye that accommodates to objects at various distances so that they can be focused.

Lesion Damage or injury to tissue resulting from illness or injury.

Libido The name given in Freudian theory to the instinctual or id energy that

is the source of all psychological energy. Sometimes used to refer specifically to sexual motivation.

Limbic system A group of anatomical structures surrounding the brain stem; thought to be involved with motivated behavior and emotion.

Logical thinking Thinking that proceeds in accordance with the well-defined rules of logic, in which a conclusion follows from premises which are accepted as true.

Long-term memory (LTM) A large-capacity, essentially permanent memory store.

Looming A perceptual phenomenon occurring when an object appears to be directly approaching the observer because of a symmetrical increase in size.

Lysergic acid diethylamide (LSD) An hallucinogenic drug.

Machiavellianism A personality characteristic, measured by the Mach scale, in which the individual tends to manipulate other people for his own ends.

Macula Generally, an anatomical structure shaped like a spot; the central region of the retina; a receptor organ in the inner ear that responds to gravitational pull.

Magazine training The establishment of conditioned reinforcers by periodically providing reinforcement no matter what the subject is doing.

Malleus The outer of the three bones in the middle ear that transmit vibrations from the eardrum to the cochlea.

Mandala (1) A model of the cosmos, based on concentric shapes; often includes images of deities. (2) In Jung's theory, a magical circle that represents self-unification efforts.

Manic-depressive psychosis A severe mental disorder characterized by depression or elation or periodic shifts from one to the other.

Manifest content In dream interpretation, the content of the dream as experienced by the dreamer.

Marathon In psychotherapy, a group session of exceptionally long, uninterrupted duration.

Massed practice "Cramming"; spending all of the allotted learning time for a task during one period.

Maturation The completion of physical growth and development with its accompanying behavioral changes. Maturation is governed by both heredity and environmental conditions.

Mean A measurement of central tendency that is computed by dividing the sum of a set of scores by the number of scores in the set.

Measurement Assignment of numbers to events on the basis or rules.

Mechanistic See *Physicalistic.*

Meditational process A hypothetical process that bridges the gap between stimuli and responses.

Medulla oblongata The lowest and most posterior part of the brain, which is connected to the spinal cord. It contains several kinds of nuclei, especially those concerned with breathing, heartbeat, and blood pressure.

Melancholia A mental state of extreme depression often accompanied by bodily complaints, hallucinations, and delusions.

Memory trace A hypothetical physiological change in the nervous system during learning. Also called *engram.*

Mental age A relative measure of mental development, given as the age level at which the subject is performing.

Mental retardation A condition of subnormal intellectual development and

functioning. There is subsequent impairment of learning, social development, and maturation. Generally, classification is based on an IQ of below 70.

Mentalistic Subscribing to the principle that mental processes are distinct from physiological processes and that conscious processes can be exposed by introspection; explanations of psychological processes in terms of the operation of the mind.

Mescaline A hallucinogenic drug obtained from the peyote cactus.

Mesomorph A body type in Sheldon's system characterized by muscular build. A mesomorph has the personality charatceristics of *somatotonia.*

Metabolism A general term referring to chemical and physical processes in the body cells including the assimilation of food, the storage and utilization of energy, the repairing of tissues, and the disposal of cellular wastes.

Method of locations A method of facilitating memory by associating new items to be recalled with specific familiar locations or places.

Midbrain One of the parts of the cerebrum lying beneath the forebrain, which contains centers for vision and hearing. Also known as the mesencephalon.

Minnesota Multiphasic Personality Inventory (MMPI) A widely used paper-and-pencil personality test designed to provide a measure of a subject's similarity to various psychopathological groups.

Mnemonics A method for remembering items based on imposing an invented structure on the material to be memorized.

Model A representation of a process, an object, or an event.

Modeling In social learning theory, a form of learning in which the subject imitates the actions or reactions of another person. In behavior modification therapy, a technique based on imitation and perceptual learning.

Mongolism A form of mental retardation, often characterized by somewhat Mongoloid facial features. See *Down's syndrome.*

Monozygotic twins Identical twins arising from one zygote (fertilized egg). See *Identical twins.*

Moral anxiety Feelings of guilt.

Motion parallax (Relative motion) The apparent movement of stationary objects occurring when the observer changes position.

Motor area An area of cerebral cortex around the central fissure controlling voluntary movements of the skeletal muscles.

Multiple approach-avoidance conflict A conflict involving more than one related goal object, each of which by itself would provide the basis for an approach-avoidance conflict. Sometimes called a *double bind.*

Multiple personality A form of dissociation in which a person displays two or more relatively distinct personalities, each with its own set of memories.

Muscle spindle Receptors in muscles that signal muscular stretching.

Mutation A change in, or deformation of, a gene, causing a modification in the character that the gene determines.

Myopia The inability to see distant objects because the lens focuses in front of the retina instead of on it. (Nearsightedness.)

Mysticism A belief in a spiritual meaning or reality that is neither apparent to the senses nor rationally obvious.

Naïve realism The philosophy that perceptual experience is a mirror of the objective world.

Nanometer One billionth of a meter (.000000001 meter). Visible light has wavelengths ranging from 380 to 760 nanometers.

Nativism The view that psychological processes are mostly innate or inborn.

Natural selection The theory Darwin posed to explain evolution. Animals whose characteristics best promote survival will survive and propagate their own kind so that those characteristics will be perpetuated in the species.

Naturalistic observation A method for research in which subjects are observed in their natural setting, rather than in the laboratory. The researcher attempts to be as unobtrusive as possible.

Need A deficiency, usually due to deprivation. It may be learned or unlearned, and is often used synonomously with drive or motive.

Negative reinforcement A stimulus the removal of which increases the probability of a response.

Negative transfer The inhibitory effect of previous learning upon new learning.

Neocortex Areas of the cerebral cortex that are evolutionarily new or recent.

Nerve A bundle of nerve fibers outside the central nervous system; also sometimes used synonomously with neuron.

Nerve impulse See *Action potential*

Neuron A nerve cell, consisting of cell body, dendrites, and an axon.

Neurosis Any of several less severe personality disturbances whose primary feature is anxiety, and whose symptoms relate to attempts to handle anxiety.

Neurotic anxiety In Freud's theory, the fear that the impulses of the id will get out of control.

Neurotic depression A mild depressive reaction, usually in response to some environmental stress. The patient is quite dejected and inactive physically and mentally.

Nondirective therapy Also called client-centered therapy. A form of therapy originated by Carl Rogers in which the therapist serves mainly to reflect the feelings expressed by the patient, accepting them without evaluation.

Nonsense syllable A syllable, usually with three letters, constructed to be as devoid of meaning as possible, used often in verbal learning experiments.

Nonverbal communication Communication by means other than words. See *Body language.*

Norepinephrine An excitatory neurotransmitter substance found in the brain and in the sympathetic nervous system. Sometimes called noradrenalin.

Norm A standard for performance or behavior.

Normal distribution A bell-shaped frequency distribution which is thought to approximate the distribution of many biological and psychological characteristics. Its mathematical formula is derived from the laws of probability.

Object permanence. A term in Piaget's theory of development which refers to a child's belief that an object continues to exist even though it is no longer visible.

Objective Having an existence independent of the observer.

Obsession A thought which persists, and which one cannot get rid of. It is usually disturbing in some way.

Obsessive-compulsive reaction A neurotic reaction whose symptoms include obsessions, compulsions, or both.

Oedipus complex In Freud's theory, a conflict in which male children develop a sexual attachment to the mother and a fear of being castrated by the father.

One-bun technique A mnemonic technique based on the rhyme one-bun, two-shoe, three-tree, four-door, five-hive, six-sticks, seven-heaven, eight-gate, nine-wine, and ten-hen.

Operant conditioning A form of instrumental learning in which a particular response is reinforced, thereby increasing or decreasing its probability of occurrence. Reinforcement is contingent upon the response.

Operational definition A definition of a construct in terms of the operations one must perform to observe its effect.

Optic array James J. Gibson's term for the sheaf of focusable light rays converging on a given point in space.

Oral stage In Freud's theory, the stage of psychosexual development in which sexual gratification is achieved by way of the mouth. Divided into the oral incorporative and the oral aggressive stages.

Ordinal scale A scale in which numbers are assigned on the basis of rank. The distance between successive ranks is not known.

Organ of Corti The organ, located in the inner ear, that contains the hair cells which are the receptors for hearing.

Organism A form of life exhibiting integration and coordination of function, which has the capacity for self-maintenance. In psychology the term is often used, perhaps inappropriately, to refer to the higher animals including human beings.

Orthographic attribute In Underwood's theory of memory, the attribute of a memory relating to the physical shape of the remembered item.

Oscilloscope An electronic device for displaying waveforms on a cathode ray tube screen. Similar in some ways to a television set.

Osgood's transfer surface A three-dimensional representation, first formulated by Charles Osgood, representing positive and negative transfer as a function of stimulus and response similarity.

Ossicles Three tiny bones in the middle ear which transmit the sound vibrations from the eardrum to the cochlea.

Outside-in display A display of vehicle position arranged from the point of view of an observer looking at the vehicle from outside.

Overtones (*Partials*) Components of a complex periodic sound wave which are multiples of the fundamental, or lowest, frequency. The pattern of overtones determines the *timbre* of a musical instrument.

Pacinian corpuscle A tactile receptor found below the skin, in the joints, and in other deep tissues.

Paired-associate learning A form of verbal learning in which the subject, when presented with a particular stimulus item, must make a particular response.

Paleocortex Parts of the cerebral cortex considered to be old, with respect to evolution.

Papilla A small, nipple-shaped protuberance. Papillae are located on the skin, the tongue, and the nasal mucosa, and contain receptors for touch, taste, and smell.

Paradigm A pattern or model. In psychology, the term is often used to apply to an accepted procedure for investigating some phenomenon, such as the paradigm for studying transfer of training.

Paranoia A behavior disorder characterized by suspiciousness of others and delusions of persecution and grandeur.

Paranoid schizophrenia A category of schizophrenia in which the symptoms of paranoia are present.

Parapsychology A field of study in which the focus of interest is upon phenom-

ena such as extrasensory perception, clairvoyance, telepathy, and the influence of thought on the behavior of inanimate objects (psychokinesis).

Parasympathetic division The part of the autonomic nervous system that controls the vegetative functions such as digestion. It acts somewhat in opposition to the sympathetic division.

Part learning Learning material by breaking it into parts and learning each part separately. Distinguished from whole learning.

Pavlovian conditioning See *Classical conditioning.*

Peck order A dominance hierarchy established in a group of fowl, such as chickens; sometimes refers to any dominance hierarchy.

Penetrance A characteristic of a gene, which refers to the extent to which the traits for which it is responsible will be expressed in the face of environmental variations.

Perception Awareness or experience of objects and other environmental events by means of the senses.

Perceptual defense The hypothetical tendency to avoid perceiving threatening or otherwise unpleasant material.

Perceptual segregation The tendency to organize one's perception into figure and ground, or focus and margin.

Perceptual selection The tendency to focus upon only part of the potentially available stimuli. See also *Attention.*

Personal construct In Kelly's personality theory, a hypothetical learned process that determines how one construes a particular set of events.

Personality The relatively permanent characteristics of an individual that affect his behavior and the behavior of others toward him, and that differentiate him from other people.

Phallic stage In Freud's theory, the stage of development in which sexual motivation is focused upon stimulation of the genitalia.

Phallic symbol A symbol representing some aspect of sexual experience.

Phenomenology The study of the experience of objects and events, in contrast with the study of the objects and events themselves. Sometimes contrasted with behavioristic approaches to psychology.

Pheromone A chemical, secreted by one member of an animal species that communicates, usually through the sense of smell, with another member of the species.

Phlegmatic A temperamental characteristic in Hippocrates's system. The phlegmatic person is slow, calm, composed, and undemonstrative.

Phobia An irrational fear.

Phoneme The smallest unit of speech.

Physicalistic explanations Explanations of phenomena in terms of physics and chemistry.

Pigment A substance that absorbs certain wavelengths of light and reflects others. The light reflected accounts for the color of the pigment. Visual pigments, contained in the rods and cones, absorb the light that ultimately results in visual experience.

Pitch The psychological attribute of sounds that corresponds approximately to the fundamental frequency of the waveform.

Pituitary gland A gland at the base of the brain which secretes hormones that control the output of other endocrine glands, growth and maturation, metabolism, and water balance.

Pleasure principle In Freudian theory, the principle whereby the id operates. It is concerned only with whether an experience is pleasurable or painful.

Polygraph An instrument used to record various physiological measures such as galvanic skin response, heart rate, etc.

Pons A part of the hindbrain containing large bands of nerve fibers connecting the lobes of the cerebellum, pathways going to and from higher centers, and many vital nuclei.

Positive transfer As a result of previous learning, a new task is easier to learn.

Postsynaptic neuron. A neuron that receives the information from the axon of a presynaptic neuron.

Precognition An alleged ability to predict events in the future, without the benefit of sensory information.

Preconscious Referring to processes that are intermediate between unconscious and conscious. Preconscious processes may become conscious from time to time.

Prediction, actuarial Prediction of a trend or average tendency of a group of subjects, as opposed to prediction of the behavior of an individual.

Prediction, clinical Prediction of the behavior of an individual.

Prefrontal lobotomy A form of psychosurgery in which the connections between the prefrontal areas of the cerebral cortex and the thalamus are cut.

Premack principle In operant conditioning, the principle that the opportunity to perform a highly probable behavior can serve as a reinforcer for behavior that is low in probability of occurrence.

Prejudice Beliefs about an individual or a group that are formed on the basis of insufficient evidence and are relatively insensitive to change by new evidence or other forms of persuasion.

Preoperational stage In Piaget's theory of development, the stage (ages 2 to 7 years) before the stage of concrete operations. The child learns to use symbols but not abstractly, and thought is egocentric.

Presynaptic neuron The neuron whose axon transmits information across the synapse to the postsynaptic neuron.

Primacy effect In verbal learning, the tendency to recall items at the beginning of the list better than items in the middle.

Primary group A reference group with which a person spends a great deal of time, which exerts a major influence on his behavior, beliefs, and standards.

Primary receptive area An area of the cerebral cortex that receives afferent information from a sense organ.

Proactive inhibition In learning, the negative influence of previously learned material on the recall of new material. When the influence is on the learning of the new material, it is called negative transfer.

Process schizophrenia A form of schizophrenia for which the symptoms are slow in onset, beginning at a relatively early age, and for which the prognosis is relatively poor.

Projection A defense mechanism in which the individual attributes one or more of his own unacceptable motives to other people.

Projective test Any of several relatively unstructured personality tests in which the patient, by making a response, presumably projects some aspect of his personality into the response.

Prolactin A hormone secreted by the pituitary gland that stimulates the production of milk in mammals and brooding in birds.

Proprioception Input from receptors that sense position and movement of the limbs and the body in space.

Proximity A Gestalt law of organization which asserts that elements which are close to one another will tend to be perceptually organized together.

Psilocybin A hallucinogenic drug found in certain mushrooms.

Psyche The mind.

Psychiatrist A medical doctor who has been trained in the treatment of personality disturbances.

Psychic energy In Freud's system, the energy, like physiological energy, which is involved in psychological processes. It is organized into instincts, or motives.

Psychoanalysis A theoretical approach to personality and psychotherapy originated by Sigmund Freud. It stresses the controlling influence of unconscious motivational processes in behavior and the importance of early experience in the development of the adult personality.

Psychodrama A method of therapy originated by Moreno, in which patients act out plays in which the roles are those of significant people in their lives.

Psychodynamic A term referring to processes that motivate behavior, particularly unconscious processes.

Psychological determinism The operating assumption that all behavior is determined, i.e., caused, by some process which is potentially understandable.

Psychometrics The field specializing in the development and utilization of tests for the measurement of behavior, traits, characteristics, attributes, etc.

Psychopathic personality See *Sociopathic personality.*

Psychopathology A general term referring to personality deviations, mental illness, etc.

Psychosexual development In Freud's theory of personality, the development of modes of gratifying sexual instincts.

Psychosis Any of several severe personality disturbances characterized by distortions in affect, thinking, and social behavior. See *Schizophrenia* and *Manic-depressive psychosis.*

Psychosocial crises In Erikson's theory of personality development, a series of stages at which critical choices must be made in regard to one's relationship to other people and to society in general.

Psychosomatics The study of physical diseases caused by psychological factors.

Psychosomatic disorder A physical disorder that has a psychological cause. Ulcers, hives, asthma, among others, *may* have psychological causes.

Psychosurgery Any of several operative procedures in which brain tissue is destroyed with the aim of reducing or eliminating disturbing psychological symptoms or behavior.

Psychotherapy Any of several techniques employing psychological, rather than physiological, methods for treating personality disturbances.

Punishment Presentation of an unpleasant stimulus for the purpose of elimi nating undesirable behavior.

Pupil The opening, surrounded by the iris, through which light passes into the eye.

Pure line A line of animals that are relatively homogenous genetically.

Pure tone A sinusoidal sound wave composed of only one frequency.

Rapid eye movement (REM) One component of paradoxical sleep, characterized by rapid eye movements, an EEG like that of light sleep, and difficulty in waking. Many dreams are thought to occur in this stage of sleep.

Ratio scale A scale of measurement with a true zero point.

Rational-emotive therapy A form of psychotherapy originated by Albert Ellis, in which the patient is led to question the assumptions that he uses in thinking about himself and his environment.

Rationalization A defense mechanism whereby one interprets his behavior in terms of some motive other than the one actually responsible for the behavior.

Reactance The tendency to resist being manipulated by other people.

Reaction formation A defense mechanism whereby one interprets his behavior as being due to a motive opposite in character to the one actually responsible for the behavior.

Reactive schizophrenia (As distinguished from process schizophrenia) A schizophrenic episode with a relatively sudden onset, apparently in reaction to some environmental stress. Chances of recovery are better than from process schizophrenia.

Readiness A concept in development referring to one's state of being ready to learn a particular skill.

Reality anxiety In Freud's theory, reality anxiety is anxiety for which there is a realistic cause, i.e., fear.

Reality principle In Freud's theory, the principle of operation of the ego, i.e., realistic as opposed to autistic thinking.

Recall A method for measuring retention of material previously learned. The material must be reproduced, verbally or in writing, either exactly in the order in which it was given (serial recall), or in any order desired by the subject (free recall).

Recency effect The tendency to recall material that was recently learned rather than earlier material; such a tendency as depicted by a serial position curve.

Receptor A structure for transducing stimulus energy into a form processable by the nervous system.

Recessive gene A gene whose characteristics are not expressed when it is paired with a dominant gene.

Recognition A test of memory in which the subject must indicate which one of a set of items was previously experienced, or is the correct answer.

Reconstruction A method for measuring retention, whereby the subject is required to piece together previously learned material, given the elements of which it was composed.

Reference group A group to which a person belongs that influences his attitudes, standards, etc.

Reflex A rapidly occurring response to a stimulus. It is usually unlearned, does not outlast the stimulus, and is relatively independent of voluntary control.

Refraction The bending of light rays when they pass from one medium to another, as through a lens.

Reification Treating an abstract concept as though it were a thing.

Reinforcement A stimulus that increases the probability of a response; the process of strengthening a response by presentation of a reinforcing stimulus.

Reinforcement, schedule of A schedule, based on time or the number of responses, for presenting reinforcements in a learning situation.

Releaser A concept in ethology, referring to stimuli that release fixed action patterns, or complex sequences of instinctive behavior.

Reliability The consistency with which a test measures whatever it measures. The tendency to make the same score on successive administrations of a test, usually expressed as a correlation coefficient.

Repression A defense mechanism whereby unpleasant or anxiety-provoking material is not permitted to come into awareness.

Respondent conditioning See *Classical conditioning.*

Response Any measurable behavior.

Retention Memory for material previously learned.

Reticular activating system A system within the brain stem that projects diffusely to the cerebral cortex, stimulation of which serves to alert, or activate, the cortex.

Reticular formation See *Reticular activating system.*

Retina The organ located at the back of the eye containing the receptors and other neural structures responsible for vision.

Retrieval A concept in the study of memory, referring to the process of finding material stored in memory.

Retrieval failure A theory of forgetting which suggests that forgetting is caused by failure in the retrieval process.

Retroactive inhibition The interfering effect of recently learned material on the recall of earlier material.

Reversibility In Piaget's theory, a property of mental operations such that an operation proceeding in one direction may also proceed in the opposite direction. It is responsible for the development of conservation of various quantities.

Rhodopsin A pigment contained in the rods of the retina; also called visual purple.

Risky shift The tendency for one to take more chances in a group situation than when alone.

Rods Receptors in the retina that are used primarily in low levels of illumination.

Role A person's function in a group; the set of behaviors expected of a person serving a particular function in a group.

Rorschach Ink Blot Test A projective personality test consisting of 10 cards, each containing a bilaterally symmetrical ink blot. The subject is instructed to tell what the blot reminds him of.

Sanguine One of the four temperaments in Hippocrates's system of personality types. A sanguine person is warm and confident.

Saturation One of the three attributes of the color experience. Saturation is the psychological correlate of purity, or number of different wavelengths in the color mixture. More wavelengths result in less saturation.

Savings method A method for measuring retention based on the number of trials required to relearn material that had been learned previously. The fewer the trials to relearn, the greater the savings.

Scheme A mental structure for dealing with experiences (in Piaget's developmental theory).

Schizophrenia One of several psychotic conditions characterized by bizarreness in thinking and withdrawal from reality.

Secondary group A reference group with which a person has less contact than a primary group but which influences his behavior in some situations.

Segmentation In speech perception, the process of dividing the acoustic wave into meaningful units. Pauses are perceived between segments, although they may not necessarily be present in the wave itself.

Self-actualization In Maslow's theory of motivation and personality, the highest level of need; the need to become what one is capable of becoming.

Self-concept The way in which a person thinks about himself.

Self report Any of a number of methods for assessing an individual, in which the subject makes or responds to statements about himself.

Self-stimulation Generally, stimulation of oneself; also a procedure whereby a human or animal subject may administer electrical stimuli to areas of his own brain (intracranial self-stimulation).

Self theory Any of a number of theories of personality that focus upon one's self-image, self-perception, etc.

Semantic differential A method for measuring connotative meaning of concepts that provides a score on three dimensions: activity, potency, and evaluation.

Semantics The study of the meanings of words; more generally, the study of the relationships between signs and the events to which they refer.

Semicircular canals Three bony tubes in the inner ear, which contain receptors responsive to acceleration resulting from body rotation. They are partly responsible for maintaining equilibrium and posture.

Sensation A term referring to an experience resulting from stimulation of a sense organ; a feeling.

Sensitivity training Any of several procedures, used with groups of people, designed to increase the awareness of other people and one's effect upon them.

Sensitization An increase in sensitivity to some stimulus.

Sensorimotor stage The first stage in Piaget's theory of development, in which one's knowledge of the world is represented in terms of movements and their sensory consequences.

Sensory deprivation A procedure used in experiments whereby the subject is deprived of much of the usual sensory input.

Sensory memory One of several hypothesized memory stores. In sensory memory the input is stored in relatively raw form.

Serial learning A procedure used in verbal learning in which the subject must memorize a list of material and recite it in order.

Serial position curve A graphic representation of the amount of material recalled as a function of its serial position in the list in which it was presented.

Serotonin An inhibitory neurotransmitter.

Servo system A closed-loop system in which behavior of one part affects, through feedback, all other parts of the system.

Set A predisposition to respond in a particular way; in problem solving, a tendency to persist in solving a problem according to a particular procedure.

Sex-linked characteristic A hereditary characteristic determined by a gene carried on the X or the Y chromosome, which also determines sex.

Sexual deviation Sexual behavior which is in violation of accepted norms as regards method or target.

Shadowing A procedure used in studies of attention, in which the subject must repeat word for word a message as it is being presented.

Shaping In operant conditioning, the procedure whereby the desired behavior is gradually "put together" from its components, each of which is reinforced at first.

Shock therapy A form of treatment of mental illness in which the patient is put into a coma, either by passing an electric current through the brain or by depriving the brain of sugar through the use of insulin.

Short-term memory (STM) One of several hypothetical memory stores. STM has a persistence on the order of 30 seconds but can be prolonged by rehearsal. It is of limited capacity, about 7 items.

Similarity One of the Gestalt laws of organization, which says that elements that are similar to one another will tend to be grouped together.

Simple schizophrenia A form of schizophrenia characterized by withdrawal, indifference, and apathy.

Sine wave A periodic waveform that represents the trigonometric sine as a function of angle; any complex waveform may, through Fourier analysis, be analyzed into a series of sine waves.

Skinner box An apparatus, containing a lever or some other response device and a means for delivering reinforcement, which is used in studies of operant conditioning.

Social comparison The process of determining one's own standards on the basis of the behavior of others, or using the behavior of others for purposes of evaluating one's own behavior.

Social facilitation The tendency for individuals to perform better in the presence of other individuals than alone.

Social motive A motive whose satisfaction requires the presence of at least one other person.

Sociopathic personality A behavior disorder in which little if any anxiety is present, and behavior is in clear violation of social norms.

Somatic nervous system The part of the nervous system that supplies the skeletal muscles and peripheral sense organs (as distinguished from the autonomic nervous system).

Somatic therapy Any of several forms of therapy for mental illness involving physical treatment, including drugs, shock therapy, etc.

Somatotonia A temperamental characteristic associated with mesomorphy. The somatotonic individual is restless, aggressive, noisy, competitive, and active.

Somatotype A category of body build. Sheldon's system uses three main categories, mesomorphy, endomorphy, and ectomorphy.

Somesthesis Perceiving stimulation of the body surface.

Source traits In Cattell's system, the personality traits that are the basic causes of one's overt, or surface, behavior.

Spontaneous recovery Recovery of a conditioned response that occurs after a rest period following extinction.

Standard deviation A measure of variability in a group of scores.

Standardization The establishment of norms or standards for administering, scoring, and interpreting a psychological test. It usually involves administering the test to a large group of people representative of those for whom the test is intended.

Stapes The third of the three tiny bones in the middle ear that conduct the sound vibrations from the eardrum to the cochlea.

Status The relative position of a person in a group.

Stereogram A set of two pictures taken from two different points of regard so that retinal disparity is simulated. Viewing a stereogram in a stereoscope results in setereoscopic vision.

Stereopsis Stereoscopic vision; the capacity to combine two disparate images into a single, three-dimensional percept.

Stereotype A set of oversimplified or overgeneralized beliefs about a group of people.

Stimulant Any of several substances that increase physiological activity and alertness.

Stimulus An energy or energy change that can excite a receptor.

Stimulus generalization The tendency to respond to stimuli that are similar to a conditioned stimulus.

Structuralism The point of view that psychology should attempt to analyze psychological phenomena into its components and determine how the components are synthesized; an early school of psychology focusing upon the analysis of consciousness into its components through the method of introspection.

Subjective Private and unverifiable by others, e.g., subjective experience.

Sublimation A defense mechanism in which an acceptable activity is substituted for an unacceptable activity pertaining to some motive.

Subvocal speech Speech that is at too low a level to be heard, but which is strong enough to stimulate the proprioceptive system associated with its production.

Successive approximations A form of shaping in which components of the final response to be learned are gradually reinforced.

Superego In Freudian theory, the part of the personality concerned with right and wrong.

Surface traits In Cattell's approach to personality, the typical behaviors of an individual, as opposed to the underlying source traits that are the basic causes of the behavior.

Syllogism (Syllogistic reasoning) A logical form that consists of two premises and a conclusion.

Symbol A stimulus that stands for something else, e.g., a word, picture, or image that stands for something other than itself.

Synapse The point of functional contact between an axon of one neuron and the dendrites or cell body of another neuron.

Syndrome A group of symptoms that go together and (usually) characterize a particular disease or condition.

Syntactics The study of the rules of language, particularly of sentence production.

T-group A sensitivity training group.

T-score A score on a test which is transformed to a score on a scale with a fixed mean and standard deviation.

Tachistoscope An apparatus for presenting visual stimuli for brief, controlled periods of time.

Task complexity The number of elements in a task.

Telepathy An alleged phenomenon whereby one person can communicate with another without benefit of the known sensory channels.

Temperament Personality characteristics relating to mood, activity, and energy levels.

Template matching A theory of pattern recognition which suggests that patterns are recognized by being matched to internally stored templates.

Temporal maze An apparatus for studying alternation learning.

Test anxiety The tendency to become anxious when one is being tested.

Testosterone A sex hormone secreted by the testes, which is responsible for many male primary and secondary sexual characteristics.

Texture gradient The rate of change of density of the elements of texture from a surface as it is projected onto the retina. The texture gradient is one variable responsible for three-dimensional vision.

Thalamus One of the main structures of the diencephalon of the forebrain. It contains nuclei that relay information to the cerebral cortex.

Thematic Appreciation Test (TAT) A projective personality test consisting of a set of pictures of various scenes about which the subject is instructed to tell a story.

Theory A set of general principles that explains existing facts and permits the prediction of new facts.

Thirst A drive related to water deprivation; the sensations arising from water deprivation.

Timbre The attribute of tonal sounds which is the correlate of waveform complexity. The characteristic tone quality of a voice of a musical instrument.

Token A secondary reinforcer that can be exchanged for a primary reinforcer, e.g., as in a "token economy."

Token economy A form of social organization, usually within an institution, in which various desired behaviors are rewarded by tokens that can be traded for other reinforcers.

Trace In theories of memory, the hypothetical residual effect of stimulation, used to explain memory.

Tracking A form of skilled behavior in which a controlled element, usually denoting the position of a vehicle, is made to pursue a moving target (pursuit tracking) or a movable controlled element is kept on a stationary target (compensatory tracking).

Trainable mentally retarded (TMR) A category of mental retardate with IQ from 25 to 50, who can be trained in the simple skills necessary for living in a sheltered situation.

Trait In respect to personality, a relatively persistent characteristic or attribute that serves to distinguish one person from another.

Trait approach An approach to the study of personality based upon the identification and assessment of personality traits, and understanding their implications for behavior.

Tranquilizer Any of several drugs that relieve anxiety without inducing sleep.

Transduction The conversion of energy from one form to another.

Transfer index A measure of the ability to apply what one has learned previously to new situations. It is based upon performance in discrimination learning tasks but is presumably independent of overall learning ability.

Transfer of training The influence of previous learning on performance in a new situation. It may be positive or negative, depending upon whether the previous learning helps or hinders performance.

Transference In psychoanalytic theory, the stage of therapy in which the patient begins to respond to the analyst as though he were some significant person (e.g., mother or father) in the patient's past.

Transmitter substance A chemical, secreted by axon terminals, which excites or inhibits an adjacent neuron. Transmitters are responsible for synaptic action.

Trial-and-error learning Learning or problem solving in which an assortment of responses is attempted and the incorrect or ineffective ones eliminated, the effective ones being strengthened.

Trichromatic theory A theory of color vision, called the Young-Helmholtz theory, which posits the existence of three basic receptor types, each sensitive to a limited region of the visible spectrum.

Tympanic membrance The eardrum, separating the middle ear from the external auditory canal.

Type In personality theory, a group of individuals having certain characteristics

in common. Typologies are usually based upon a very limited set of categories and thus are not often accepted by psychologists.

Ultrasonic Referring to vibrations whose frequency is above the upper limit of human hearing.

Ultraviolet Radiation whose wavelength is below that of violet light, i.e., below about 380 nanometers.

Umweg learning Detour learning. The subject must learn to move away from a goal in order to get around a barrier that prevents direct access to the goal.

Unconditioned response (UCR) An unlearned response to a particular unconditioned stimulus, e.g., salivation to food in the mouth or withdrawing from a painful stimulus.

Unconditioned stimulus A stimulus that elicits an unconditioned response.

Unconscious processes Psychological processes that affect behavior and experience, but of which one is not aware.

Utricle An organ within the inner ear, which contains receptors sensitive to gravitational pull.

Validity The extent to which a test measures what it is intended to measure. The correlation of a test score with some criterion.

Value A belief that relates to one's behavior or goals.

Variable A quantity that can take on more than one value.

Variable interval schedule A schedule of reinforcement in which the first response following a given interval of time is reinforced. The length of the interval, however varies from trial to trial.

Variable ratio schedule A schedule of reinforcement in which every *n*th response is reinforced, with *n* varying from trial to trial.

Viscerotonia A temperamental characteristic associated with the endomorphic body build. The viscerotonic individual is friendly, comfort-loving, dependent, slow, and relaxed.

von Restorff effect An effect often found in verbal learning studies in which an item that is isolated in some way or distinct from other items in a list will be remembered better.

Wavelength The distance between successive peaks in a periodic waveform.

Wernicke's area An area within the temporal lobe of the brain that is involved in language perception.

Whole learning A learning strategy in which all of the material to be learned (e.g., a whole list) is practiced before it is repeated. It is to be distinguished from *part learning.*

Yerkes-Dodson law A statement that performance is a curvilinear function of arousal or motivation, showing first an increase and then a decrease as arousal or motivation is increased.

Zygote A fertilized eggcell.

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